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AN OUTLINE OF
EXPERIMENTAL EDUCATION

By the same author

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THE DOCTRINES OF THE GREAT EDUCATORS

AN OUTLINE OF EXPERIMENTAL EDUCATION

BY

ROBERT R. RUSK

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PREFACE

IN 1912 the writer published an *Introduction to Experimental Education*,[1] and in 1919 a revised and enlarged edition under the title *Experimental Education*.[2] The stereos of the latter were destroyed in the London Blitz. The present book is a new work on different lines and is intended to complement readings in educational psychology for students in training and university diploma students of education. It is also hoped that it may induce research workers to prosecute further some of the issues raised in these pages.

The title has reverted to a less ambitious form, as it is now impossible even to attempt an exhaustive presentation of the various topics; for example, a bibliography of Follow-up Studies alone comprises 471 items[3] and an *Index to Professional Literature on Reading and Related Topics* (to 1 January 1943)[4] lists 8258 references. The Educational Records Bureau of New York has issued three monographs — *Ten Years of Educational Research in Reading*, Summary and Bibliography by A. E. Traxler, 1941 (618 items), *Another Five Years of Research in Reading*, 1946 (527 items), by A. E. Traxler and A. Townsend, and *Eight More Years of Research in Reading*, Summary and Bibliography, by A. E. Traxler and A. Townsend, 1955

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[1] Longmans, Green & Co.

[2] Translated into Polish, 1924.

[3] Michigan Study of the Secondary School Curriculum State Board of Education (Lancing: 1943), No. 1. *Follow-up of Secondary School Students*, Preface.

[4] A. E. Betts and T. M. Betts (American Book Company, 1945).

(760 items). The file-cards of the Index Catalogue of the Bureau of Educational Research of the Ohio State University College of Education numbered 340,000 in 1951. The examples cited in the succeeding chapters must consequently be regarded merely as illustrations of the various developments in experimental education.

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CHAPTER I

INTRODUCTORY[1]

ANY departure from traditional practice may be regarded as an experiment. In this sense the history of education affords innumerable examples of experiments in education. Some classicists regard this type as the only valid form of experiment; they equate experiment to experience and decry scientific experiments in education as dangerous.[2] If it is true that history repeats itself, the same experiments have been made over and over again, but not under the same conditions, and accordingly do not meet the requirements of a technical experiment.

At the opposite extreme from the educational die-hards who dread experiment stand the schools which pre-empt the title 'experimental', although their only justification for the designation may be only some innovation introduced without forethought and without provision for the evaluation of the outcome in a scientific manner. These schools appeal to the authority of John Dewey, who entitled his philosophy of education 'experimentalism', on the ground that 'from the scientific side it is demonstrated that effective and integral thinking is possible only where the experimental method is used'.[1] Dewey's renowned lieutenant adds:[2] 'Each new situation is a problem demanding study and thought. We try out our best thought plan; we watch whether it works. Each new program is thus an experiment. Amid changing conditions we live experimentally, must do so.'

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[1] E. Meumann, *Vorlesungen zur Einführung in die experimentelle Pädagogik* (Leipzig: W. Engelmann, 1911, 2nd edition).

P. Müller, *Ernst Meumann als Begründer der experimentellen Pädagogik* (Bazenheid: E. Kalberer, 1942).

W. A. Lay, *Experimentelle Pädagogik* (Leipzig: B. G. Teubner, 1908). Translated by Adolf Weil and Emanuel K. Schwartz (New York: Prentice-Hall Inc., 1936).

Raymond Buyse, *L'Expérimentation en pédagogie* (Bruxelles: Maurice Lamartin, 1935).

W. Wolter, *Analyse expérimentale du travail des écoliers*: La Psycho-pédagogie d'Ernest Meumann (Louvain: E. Nauwelaerts, 1955).

P. Otto Drese, *La Didactique expérimentale de W. A. Lay* (Louvain: E. Nauwelaerts, 1956).

[2] Cf. Lane Cooper, *Experiments in Education* (Cornell University Press, 1943). P. 2: 'Let us therefore call the first great experiment in education the pagan or Hellenistic, and the second, most significant of all, the school of Christ and his disciples. These two we take to represent *experientia*, the thing that teaches man.' Also p. 3: 'Experiments are dangerous in education. It is a fearful thing to disregard experience and try sophistical experiments with human souls.'

Great advances in thought have nevertheless been effected without the aid of experiment; we need only instance Darwin's theory of evolution and Freud's discovery of the Unconscious. Some aspects of education are not amenable to experimental control; the objectives of education which are determined by ethical and social considerations may be cited. Where nevertheless an issue can be so staged as to be susceptible to experiment there is no excuse except that of less effort and expense for using another method; it is the ultimate method.[3] When an issue has been decided experimentally the result acquires objective validity. If the experiment has been properly planned and accurately described, it can be repeated by any other investigator, and the same result should be attained. There can be no further discussion on the subject, at least by those who adopt the scientific attitude; the only answer to a conclusion reached experimentally is further experiment.

[1] John Dewey, *How We Think* (Boston: D. C. Heath & Co., 1933), p. 188.

[2] W. H. Kilpatrick, *Remaking the Curriculum* (New York: Newsom & Co., 1936), p. 15.

[3] Truman L. Kelley, *Scientific Method*: Its Function in Research and in Education (Columbus: The Ohio State University Press, 1929), p. 27.

As the later chapters of this work illustrate, experiment is gradually invading the various fields of education, and to the extent that educationists are prepared to submit problems to experimental verification will education become scientific and receive the respect due to a subject which is something more than a collection of individual opinions or a set of professional prejudices.

CHAPTER II

APPLICABILITY OF EXPERIMENT TO EDUCATION

THE application of experiment in education, as in the other social sciences, is beset with difficulties. John Stuart Mill (1806–73), who formulated the canons of inductive inference [1] from which the experimental technique is derived, realised [2] that the 'interference of causes' and the 'intermixture of effects' rendered it extremely improbable for the variations in social situations to be 'insulated' and remain sufficiently stable for scientific observation or experiment:

> The first difficulty which meets us in the attempt to apply experimental methods for ascertaining the laws of social phenomena, is that we are without the means of making artificial experiments. Even if we could contrive experiments at leisure, and try them without limit, we should do so under immense disadvantage, both from the impossibility of ascertaining and taking note of all the facts of each case, and because (these

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[1] The most important canons are:

First Canon: If two or more instances of the phenomenon under investigation have only one circumstance in common, the circumstance in which all the instances agree is the cause (or effect) of the given phenomenon.

Second Canon: If an instance in which the phenomenon occurs and an instance in which it does not occur, have every circumstance in common save one, that one occurring only in the former, the circumstance in which alone the two instances differ is the effect, or the cause, or an indispensable part of the cause, of the phenomenon.

Fifth Canon: Whatever phenomenon varies in any manner whenever another varies in some particular manner, is either a cause or an effect of that phenomenon, or is connected with it through some facts of causation.

[2] J. S. Mill, *A System of Logic*; Ratiocinative and Inductive (London: Longmans, Green & Co.), Bk. VI, chap. vii, § 2, People's Edition, 1898, p. 574.

facts being in a perpetual state of change) before sufficient time had elapsed to ascertain the result of the experiment, some material circumstance would always have ceased to be the same. . . . There is thus a demonstrated impossibility of obtaining in the investigations of the social science the conditions required for the most conclusive form of inquiry by specific experience.

In spite of the significance assigned to the experimental method in his philosophy Dewey (1859–1952) has likewise to concede:[1] 'What purports to be experiment in the social field is very different from experiment in natural science; it is rather a process of trial and error accompanied by some degree of hope and a great deal of talk'.

The dilemma to which we have alluded may be resolved not by rejection of the recalcitrant data of social phenomena but rather by the adoption of an experimental technique not derived with all its refinements from the exact physical sciences but more appropriate to the complexity and interdependence of the components constituting social phenomena.

Moral issues which until recently were not thought to be pertinent to experiments in the physical field, are involved in experiments in the social sphere. The right to experiment on human beings has been challenged. But in the past changes have been effected in the social structure and modifications made in educational practice, and surely we cannot deny to the present age the right to make changes or to experiment that previous ages enjoyed, and alterations can only by accident be improvements unless they are directed by conscious planning and controlled by careful experiment. The principles enunciated in framing experiments in education have been thus formulated:[2]

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[1] J. Dewey, *Freedom and Culture* (London: George Allen & Unwin, Ltd., 1940), p. 65.

[2] 'The Ethics of Experiment', *The Times Educational Supplement* 12 August 1955, p. 847.

All changes should be contemplated in terms of their remediability; the irrevocable should be suspect until, so far as is humanly possible, proved unavoidable. If we think of experiments by the teacher, the headmaster and the administrative body, it seems that the moral element involved increases with the degree of authority. In the classroom there is, or there ought to be, a quicker realisation of the effects and greater ease of readjustment than are possible when the school as a whole or the community is affected. Sometimes the opposition of staff or parents may check the precipitancy of a headmaster's reforming zeal that would introduce changes ethically open to question because in one way or another they mean an abrogation of rights. Perhaps the final judgment will in practice be made by the consensus of educational opinion which, for the most part inarticulate and unformulated, can in a democratic community ultimately make itself felt and prevail.

Kurt Lewin (1890–1947), who has been responsible for the introduction of new and profitable techniques for the study of social groups, has admitted:[1]

> It is only recently that some of us have lost the prejudice according to which the description of a large unit is less scientific than the description of a small unit.
>
> Even those among us who in principle do not like to discriminate against large units have to face a task which is new and a bit frightening even to the brave soul. It raises the question: can we hope to use as objective a description and measurement of large social units as we have been able, at least to the degree we have learned to characterise and measure small units; is there any way to keep up our standards of reliability and objectivity? At present I feel that the social scientist is threatened by the Scylla of losing his 'objectivity' by the attempt to deal with sufficiently large and meaningful units on the one hand, and by the Charybdis of losing the 'validity' of his study by dealing with inadequate and frequently too small units.

and has advised:

> The social scientists, perhaps more than the natural scientists, have to learn to be unafraid and at the same time

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[1] 'Frontiers in Group Dynamics', *Human Relations* (London: The Tavistock Institute of Human Relations), vol. i, pp. 152-3.

> fair-minded. To my mind, fairmindedness is the essence of scientific objectivity. The scientist has to learn to look facts straight in the face, even if they do not agree with his prejudices. He must learn this without giving up his belief in values. . . . He has to learn to understand how scientific and moral aspects are frequently interlocked in problems, and how the scientific aspects may still be approached.

Even in classical times attempts were nevertheless made to control conditions in the interests of scientific investigation of social problems, as in the Becos story in Herodotus (484 B.C.–430 or 429 B.C.) :[1]

> Now the Egyptians, before the reign of their king, Psammetichus, believed themselves to be the most ancient of mankind. Since Psammetichus, however, made an attempt to discover who were actually the primitive race, they have been of opinion that while they surpass all other nations the Phrygians surpass them in antiquity. This king, finding it impossible to make out by dint of inquiry what men were the most ancient, contrived the following method of discovery. He took two children of the common sort, and gave them over to a herdsman to bring up at his folds, strictly charging him to let no one utter a word in their presence, but to keep them in a sequestered cottage, and from time to time introduce goats to their apartment, see that they got their fill of milk, and in all other respects look after them. His object herein was to know, after the indistinct babblings were over, what word they would first articulate. It happened as he had anticipated. The herdsman obeyed his orders for two years, and at the end of that time, on his one day opening the door of their room and going in, the children both ran up to him with outstretched arms, and distinctly said 'Becos'. When this first happened the herdsman took no notice; but afterwards when he observed, on coming often to see them, that the word was constantly in their mouths, he informed his lord, and by his command brought the children into his presence. Psammetichus then himself heard them say the word, upon which he proceeded to make inquiry what people

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[1] *History of Herodotus*, translated by George Rawlinson (London: John Murray, 1880), Bk. II, chap. 2, vol. 2, pp. 2-3.

there was who called anything 'becos', and hereupon he learnt that 'becos' was the Phrygian name for bread. In consideration of this circumstance the Egyptians yielded their claims, and admitted the greater antiquity of the Phrygians.

The experiment was repeated by King James IV of Scotland (1488–1513),[1] doubtless to substantiate the Highlanders' assumption that Gaelic was the language of the Garden of Eden: 'he put a baby with a dumb woman on the Bass Rock, to find what language it would speak when left to itself'.

Such early efforts at controlled investigation should encourage us to make the attempt to apply experiment in education.

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[1] P. Hume Brown, *A Short History of Scotland* (Edinburgh: Oliver & Boyd, 1947), p. 262. The Revised and Enlarged Edition of 1951, p. 147, gives this version — 'The story goes that he put two children with a dumb woman on Inchkeith in the Firth of Forth to find what language they would speak when left to themselves'.

CHAPTER III

MEASUREMENT IN EDUCATION[1]

ACCORDING to A. N. Whitehead,[2] it was the substitution of measurement for classification that signalised the inauguration of the scientific age. 'The popularity of Aristotelian logic retarded the advance of physical science throughout the Middle Ages. If only the schoolmen had measured instead of classified, how much they might have learnt. . . . Classification is necessary. But unless you can progress from classification to mathematics your reasoning will not take you very far.' An adequate standard of measurement which has been defined as the assignment of numbers to observable phenomena, or the quantitative evaluation of a property, is a prerequisite of any scientific treatment of education, as it is essential for the accurate estimation of changes incidental to experiment.[3]

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[1] For history of measurement in education see B. Othanel Smith, *Logical Aspects of Educational Measurement* (New York: Columbia University Press, 1938), chaps. 1-3. For comprehensive account see E. F. Lindquist (ed.), *Educational Measurement* (Washington, D.C.: American Council on Education, 1951).

The journal *Educational and Psychological Measurement* is published quarterly at Mount Royal and Guilford Avenues, Baltimore, Maryland, and Durham, North Carolina.

[2] *Science and the Modern World* (Cambridge University Press, 1926), p. 37.

[3] Apart from its function in experiment measurement may have a value in itself for education. The efficiency of certain articles of school equipment — desks, tables, etc. — rests on the results of the physical measurement of pupils. Cf. *Standards for School Dining Tables and Chairs, etc.* (London: British Standards Institution, 1955). Also, *Basic Body Measurements of School Age Children*: A Handbook for school officials, architects and design engineers in planning school buildings, furniture and equipment. Prepared by W. Edgar Martin. (Washington, D.C.: U.S. Department of Health,

The ubiquity of measurement is illustrated by McCall[1] by such simple instances as the milestone, the hand of the watch, the humble cup in the kitchen, and he adds that measurement is just as immanent in the whole educational process as in life in general; and he concludes, somewhat unwarrantably, that there are other things in education besides measurement, but they have no value so long as they are dissociated from it.

That measurement is universally applicable to all aspects of education is the measurer's creed. Thorndike is the apostle of measurement in education. The articles of his creed run:[2] 'Whatever exists at all exists in some amount. To know it thoroughly involves knowing its quantity as well as its quality.' The measurer's creed, as formulated by Thorndike, suffers like most creeds from the difficulty of applying it in practice, for as yet it has been found impossible to devise techniques for assessing certain features of the educational process.

McCall[3] has asserted that there is never a quantity which does not measure some quality, and never an existing quality that is non-quantitative. The popular view is nevertheless that quantities are measurable whereas qualities are not. The distinction is, however, not absolute, and it has been argued that qualities differ from quantities merely by being phenomena to which no numbers have as yet been assigned.[4] The assumption

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Education and Welfare, Office of Education, 1953.) And, *Children's Body Measurements for Planning and Equipping Schools*. Prepared by W. Edgar Martin. (Washington, D.C.: U.S. Department of Health, Education and Welfare, Office of Education, 1956.)

[1] W. A. McCall, *Measurement* (New York: The Macmillan Co., 1939), p. 22.

[2] E. L. Thorndike, 'The Nature, Purposes and General Methods of Measurement of Educational Products' in *The Seventeenth Yearbook of the National Society for the Study of Education* (Bloomington, Illinois: Public School Publishing Co., 1918), pt. ii, p. 16.

[3] P. 15.

[4] A. S. C. Ehrenberg, 'Measurement and Mathematics in Psychology', *The British Journal of Psychology*, vol. xlvi, pt. 1, February 1955, pp. 20-9. Cf.

that quantities only and not qualities are measurable, may have an adverse effect on education, for it may lead to emphasis on the superficial aspects of subjects which are more readily assessable. The emphasis on quantity to the neglect of quality likewise tends to make speed the criterion of efficiency as in the timing of mental and scholastic tests.

In general we may say that the type of measurement must be appropriate to the content of the subject matter. For, as Aristotle has observed,[1] it is the mark of a man of culture not to expect a greater degree of accuracy than the nature of the subject-matter warrants. Whitehead [2] has expressed the same idea succinctly: ‘The truth must be seasonable’. And a modern writer [3] gives his version of Aristotle's dictum thus: ‘“An educated man is one who knows when a proposition is proved”; one who knows how to judge fairly and critically the arguments purporting to lead to some conclusion; who knows, therefore, the kind of argument and the kind of evidence that is relevant to a given kind of inquiry. He will not ask for a mathematical argument about (say) the ethics of slavery, nor a scientific argument about the history of music, nor a philosophic argument about the size of the universe. He has an instinctive recognition of the right method to apply to a given problem.’

If the advocates of measurement in education make somewhat extravagant claims for their subject, certain of the critics of educational measurement adopt too

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G. A. Lundberg, *Social Research* (New York: Longmans, Green & Co., 1942, 2nd edition), p. 23. ‘The assumed conflict between qualitative and quantitative methods must be abandoned in favour of the view that these terms merely represent different stages of refinement and objectivity in our technique of description.’

[1] *Ethics*, Bk. 1, chap. 3.

[2] A. N. Whitehead, *Adventures of Ideas* (Cambridge University Press, 1933), p. 311.

[3] E. F. Caldin, ‘History and Philosophy of Science’, *Universities Quarterly*, vol. 6, no. 4, August 1952, p. 350.

restricted a standpoint; they prejudge the issue by contending that the only valid type of measurement is that exemplified in the physical sciences. Thus, 'it may be argued', urges Hardie,[1] 'that I have assumed that measurement in education must be similar to measurement in physics, and that such an assumption need not be true. But it is true.' And he continues, 'that wherever measurement can be applied, there the methods of physics are appropriate'. Such writers have nevertheless reckoned without regard to the revolutionary developments in the concepts of the physical sciences, for in quantum mechanics, 'measurement, however exact, inevitably involves certain gross errors of observation'.[2] For 'fundamental' measurement, the most exacting type, the units of measurement must be shown to be equal by experimental demonstration. B. O. Smith accordingly states [3] that if we are to obtain units really equal in educational measurement, there must be some system of physical operation by which the axioms of addition are satisfied. In the succeeding paragraph he qualifies this demand for 'physical operation' by stating — 'It may be that some of the qualities dealt with in educational measurement will turn out to be capable of expression in really equal units. If this occurs, no one can predict what the particular procedure of obtaining them will be. But it can be asserted that whatever it is, it will be experimental and will publicly demonstrate that such qualities have a structure consonant to that of the axioms of addition.'

Thorndike [4] sought to counter the criticisms of educational measurement by declaring: 'Nobody need be disturbed at these unfavourable contrasts between measurement of educational products and measurements of mass, density, velocity, temperature, quality of electricity, and the like. The zero of temperature was located only a few years ago, and the equality of the units of the temperature scale rests upon rather intricate and subtle presuppositions.' But the measurement of temperature does not satisfy all the axioms of measurement, and as the pattern of educational measurement is essentially the same as the measurement of temperature,[1] Thorndike's analogy is not completely convincing.

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[1] C. D. Hardie, *Truth and Fallacy in Educational Theory* (Cambridge University Press, 1942), p. 146.

[2] Max Planck, *The Philosophy of Physics*, translated by W. H. Johnston (London: George Allen & Unwin, Ltd., 1936), pp. 24-5.

[3] *Ibid.* p. 141.

[4] *Ibid.* p. 18.

Measurement is undertaken for a purpose, and the purpose we have in view determines our selection of the means. Thus Friedman [2] points out that if a carpet is to fit a given room the size is expressed in length and breadth; if it is to be cleaned it is the area that has to be computed; if the edges are to be bound, it is the perimeter that has to be calculated. The unit of measurement must also be appropriate; the speed of sound is in physics expressed in feet per second, in aeronautics in miles per hour.

We must know what we are measuring. In assessing composition is it content, expression, grammatical correctness, spelling or handwriting, or is it all these, and, if so, what weight are we assigning to each? Supervisors of teaching practice may set out to rate students' teaching without defining whether it is knowledge of the subject matter, method of presentation, use of illustration, interest aroused in the pupils or an amalgam of all these. The quality measured must be precisely defined. It is, however, next to impossible to isolate a mental process or a scholastic product for purposes of measurement since the whole self is involved in all learning, or to select a feature for measurement which unequivocally represents a complex process.

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[1] B. O. Smith, p. 127.

[2] B. B. Friedman, *Foundations of the Measurement of Values* (New York: Bureau of Publications, Teachers College, Columbia University, 1946).

Measurement presupposes variation; it seeks to answer such questions as 'how much?' or 'how many times?' Mere enumeration, counting, would suffice if the only question was 'how many?' The measurable property must also form a continuous whole or series, that is, the objects measured must not change their character during the operation of measuring.

Our measurements of length and weight possess certain characteristics of which by reason of their very familiarity we are generally quite unaware. Thus, if A = 2 inches, B = 4 inches, C = 6 inches it does not matter whether we add A to B and B to C or the other way about beginning with C; the order is a matter of indifference in length and weight. We can likewise add together the inches 2, 4, 6 and the result will be greater than any of the individual measures. But if A floats on B and B on C, C will not float on A; the order is not reversible; and if we add A, which floats on B and on C, to C we reduce its density; density is not additive. The conditions that must be satisfied in what is termed 'fundamental measurement' are accordingly that there must be an indifference to the order of the characteristics measured, and the measures must be additive. The additive characteristic renders the property measured amenable to statistical treatment, whereas the scope of measurements dependent on order only is clearly limited.

The first condition that a property being measured must satisfy as a fundamental magnitude is that it must generate an order; the houses in a street satisfy this requirement and may be numbered, but the numbers do not represent measurable features; they serve merely to identify the houses, just as in older towns the houses had names to designate them. If, however, we select a feature like the frontage to the road, then measurement would be applicable. Teachers can arrange their pupils in a definite order in respect to general intelligence or scholastic ability with a fair degree of reliability; and in the past they have had little hesitation in grading specimens of handwriting and in assigning numbers to the ordered sequence. These numbers can, however, only be treated statistically by specially devised techniques; they are like the numbers on houses. To be measurable the ranks must be equally spaced or must represent objectively equal intervals. When this condition of measurement has not been adhered to, the usual numerical or statistical treatment is unwarranted.[1] The transformation of scales of relative position into quantitative scales, graduated in units of amount, is, according to Smith,[2] one of the big problems in measurement.

The equality of units is a prerequisite of any computation, yet in many schools marks are added and comparisons instituted without any consideration being given to this essential. Statistical techniques[3] have been applied to obtain equality of units in the assessment of intelligence and in educational products, but the validity of the application has been questioned.[4] The statistical procedure for this derivation of equal units assumes that scores or marks are normally distributed whereas this presupposition in regard to educational products is seldom justified.[1] Statistical manipulation cannot be a substitute for analysis and definition of the process or product to be measured.

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[1] For the new ranking techniques see M. G. Kendall, *Rank Correlation Methods*, 2nd edition, London: Charles Griffin & Company, 1955.

[2] *Logical Aspects of Educational Measurement*, p. 131. For a method by which the procedure of giving numerical values to quality descriptions can be made less arbitrary see D. Shepherd, 'The Adequacy of Everyday Quantitative Expressions as Measurements of Qualities', *The British Journal of Psychology*, vol. xlv, pt. 1, February 1954, pp. 40-50.

[3] For introduction to statistics see L. H. C. Tippett, *Statistics* (Home University Library. London: Oxford Press, 1943). For statistical computation — E. F. Lindquist, *A First Course in Statistics: Their Use and Interpretation in Education and Psychology* (London: George G. Harrap & Co., 1942); and H. E. Garrett, *Statistics in Psychology and Education* (London: Longmans, Green & Co., 1926).

[4] See B. O. Smith, chaps. 7 and 8, and C. D. Hardie, *Truth and Fallacy in Educational Theory*, pp. 128-47, 'The Theory of Educational Measurement'.

The final phase of measurement is attained, as we have indicated above, when the units are additive, *i.e.* when the sum of the values is different from the separate values only in quantity, as with length and weight. As instances where the total is not the same as the sum of the series considered distributively Smith cites the effect of each of a series of blows with a hammer on a surface which would not be the same if its blows were administered at quite different times, and it is a well-known fact that in psychology the same stimulus produces different effects according to its place in the total series of stimuli, and that, due to practice effect, successive applications of a test give different results; in the mental life the same cause may have different effects. The items of any series arranged in increasing order of difficulty while valuable for comparative purposes do not consequently meet the requirements of the most exacting form of measurement. It is as well for teachers and educationists to recognise from these considerations that their marks or scores have not the same statistical significance as ordinary physical units.

The attitude to be adopted in regard to measurement in education is that expressed by Thorndike in the early days of mental measurement (1918), thus:[2] 'If those who object to quantitative thinking in education will set themselves at work to understand it; if those who criticise its presuppositions and methods will do actual experimental work to improve its general logic and detached procedure; if those who are now at work in devising and in using means of measurement will continue their work, the next decade will bring sure gains in both theory and practice. Of the gains made in the past we may well be proud.'[1]

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[1] Cf. B. O. Smith, pp. 132-4.

[2] *Seventeenth Yearbook*, pt. ii, p. 24. For modern expression, see C. A. Richardson, *An Introduction to Mental Measurement and its Applications* (London: Longmans, Green & Co., 1955), chap. 1, 'Measuring the Mind'.

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[1] For lines of development, see B. O. Smith, *Logical Aspects of Educational Measurement*, chap. 9.

The Copley Medal of the Royal Society was awarded in 1955 to Sir Ronald Fisher for contributions to developing the theory and application of statistics for making quantitative a vast field of biology. *The Times*, 5 November 1955.

CHAPTER IV

INSTRUMENTS OF EDUCATIONAL EXPERIMENT

IN educational investigations the technique most frequently applied and most generally condemned is the questionnaire. Truman L. Kelley in *Scientific Method: Its Function in Research and Education,*[1] after referring to the questionnaire as 'the weakest device that has ever obtruded its prying and at times discourteous self into the respectable field of science',[2] has regretfully to confess that 'until experimental science relieves us of the need of human judgments, or removes from our minds an interest in unique events, this wayward child of science, feeble as it is, will remain an indispensable helper'. And he adds, 'It will thus always be needed, and we can but hope that it will curb its intrusive disposition and mend its unseemly ways'.

The first and almost insurmountable objection to the questionnaire procedure in education, encountered likewise in dealing with other social phenomena, is the difficulty of securing an unbiased or representative sample, since it is usually impossible to test a whole population. Rules for sampling are formulated in most works on statistics, but to observe these is onerous. Even when they are fully observed in the issue of the questionnaire, it is difficult, without exerting official pressure, to enforce the return of the completed schedules. For this reason individual workers should be discouraged from

[1] Columbus: Ohio State University Press, 1929.

[2] P. 39.

circulating questionnaires; questionnaires might be sponsored by an official body, but official bodies would be well advised to restrict the issue of questionnaires to topics of direct concern to themselves and to deal only with other official bodies who can secure compliance with the request for data.

Faulty completion of the schedules may invalidate the returns. This may be due to taxing the patience of the respondent by too lengthy a series of questions, to inadequate information for the sake of brevity, or to confusion in the planning of the schedule. Vagueness in the instructions or ambiguity in the questions may vitiate conclusions. Defective education of some classes in the community who comply with the invitation to respond, may upset all the sampling precautions; thus, in one investigation the percentage of effective returns from different classes in the population was:[1] professional and semi-professional, 80 per cent; artisans and distributive operatives, 45 per cent; agricultural workers and domestic servants, 15 per cent.

Not only should the responses be capable of objective rating but the ratings must also be susceptible to statistical treatment; a pattern of the final form in which the results are to be presented should be prepared before the schedules are issued. A small-scale try-out should always precede the general distribution.

A fatal objection to the questionnaire is that a person's expressed opinion may not correspond to his behaviour in an actual situation. How little reliance can be placed on the questionnaire technique is disclosed in a study of laterality by Hull[2] where only fourteen out of forty items corresponded in questionnaire and performance. Kurt

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[1] A. C. Patterson, 'The Questionnaire as a Means of Educational Research', *Scottish Educational Journal*, 13 November 1942, p. 698.

[2] C. J. Hull, 'A Study of Laterality Test Items', *Journal of Experimental Education*, vol. iv, 1936, pp. 287-90.

Lewin accordingly concludes:[1] 'We are slowly learning to treat them [questionnaires] as reactions to a situation which are partly determined by the question, partly by the general situation of that individual. We have to learn to treat questionnaires as we are accustomed to treat a projective technique.'

The questionnaire itself is not an experiment, but, as has been said, in spite of all its shortcomings it may be the only means available of investigating certain issues; by assembling data according to definite principles it may likewise be the first stage in an inductive approach to a problem.[2]

Some of the instruments used in educational experiment have been specially designed but others have been fashioned after the pattern of those in use in psychology and mental testing.

Binet's Scale of Intelligence, first published in 1905, introduced a new device which spread beyond the bounds of mental testing and in its subsequent development became more precise and assumed a variety of forms. It is generally accepted that Binet's chief contribution was the conception of mental age, but the fundamental feature was his insistence on objectivity,[3] and objectivity is of the essence of science. Instead of attempting to diagnose mental deficiency by a few chance questions as had hitherto been the practice, Binet adhered to a definite form of question and prescribed what type of reply should be regarded as satisfactory. It was the standardising of the questions and of the child's responses that was the basic feature of Binet's work. The new-type, objective, or standardised, test then became one of the main instruments of scholastic measurement. Its chief characteristic in contrast to the traditional type of examination is that instead of a pupil being allowed to answer in any way he chooses a question which may be general in scope and vague in expression, he is set to answer a series of definite questions, the result of an analysis of the subject-matter involved; the standardised test assesses one fact at a time, thus rendering objective marking possible.

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[1] *Field Theory in the Social Scheme* (Tavistock Publications, Ltd., 1952), p. 16.

[2] Bibliography on the questionnaire:

L. V. Koos, *The Questionnaire in Education* (New York: The Macmillan Company, 1928).

F. W. Hubbard, 'Questionnaires', *Review of Educational Research*, vol. ix, no. 5, December 1939, pp. 502-7.

F. W. Hubbard, 'Questionnaires, Interviews, Personality Schedules', *Review of Educational Research*, vol. xi, no. 5, December 1942, pp. 534-41.

H. A. Toops, 'Questionnaires', *Encyclopedia of Educational Research* (New York: The Macmillan Company).

[3] That is, obligatory for every intelligent being. Cf. B. Bosanquet, *Essentials of Logic* (London: Macmillan & Co., 1897), p. 26.

In the attempt to ensure objectivity in the assessment of scholastic achievement the mental processes involved in the testing have to be simplified and reduced to the most mechanical type. Thus mere recognition of the correct alternative is implied in the Yes-No type of test; for example:

The battle of Bannockburn was fought in 1314? Yes No

Also, in the alternative-response type; for example:

The battle of Bannockburn was fought in? 1213, 1314, 1415, 1516.

Recall, a higher mental process than recognition, is nevertheless more frequently in demand in school work, hence the new-type test had to be adapted to assess the pupil's capacity to recall information; the result is a test of the completion form:

The battle of Bannockburn was fought in? . . .

Efforts are being made to devise a form of test which, while retaining all the virtues of objective assessment, will

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yet be applicable to the higher mental processes, for example, inference.[1]

The same attention has not been devoted to the objective setting of tests as to their objective assessment. The printed instructions in paper-and-pencil tests should be couched in such clear and precise terms that the testees have no need to raise questions as to their meaning; they should also be simple enough for the dullest to understand them, otherwise we may find that complete failure to score on the part of dull pupils is due not to their inability to respond to any of the items but to their complete failure to appreciate what is expected of them. The vocabulary employed in the instructions should be scrutinised as meticulously as the terms in the items of the test.

The subject around which most controversy about objective setting revolves is spelling. Oral dictation of words is subject to all the vagaries of pronunciation, some of which might be advantageous to the pupils, others detrimental. Only a printed test is foolproof in this respect. To require pupils to correct in writing misspelt words is regarded by almost all teachers as quite subversive of orthodox practice, but it is doubtful if the objection to this technique can be sustained.[2] Provided pupils are warned, for example, by the insertion of brackets or by italics in printing, that the test words are incorrectly spelt no harm may come from the error-correction technique. The inconsistency involved in requiring pupils to correct ungrammatical sentences while condemning the correction of words in a spelling test is not usually apparent to teachers. To obviate the objection it has nevertheless been proposed that test words should be presented in the phonetic form in which they appear in dictionaries; such forms are already familiar to pupils using dictionaries, and it has not hitherto been contended that they adversely affect the spelling of pupils. Providing a skeleton form of the word omitting the difficult part has been found to give satisfactory results.[1]

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[1] Cf. J. L. Mursell, *Psychological Testing* (London: Longmans, Green & Co., 1955).

H. D. Rinsland, *Constructing Tests and Grading* (London: George G. Harrap & Co. Ltd., 1938).

H. E. Hawkes, E. F. Lindquist, C. R. Mann, *The Construction and Use of Achievement Examinations* (London, George G. Harrap & Co. Ltd., 1937).

[2] Frederick S. Breed, 'New-Type Spelling Tests', *Elementary English Review*, vol. vii, no. 3, March 1930, p. 56.

John R. McIntosh, *Learning by Exposure to Wrong Forms in Grammar and Spelling* (Bureau of Publications, Teachers College, Columbia University, New York, 1944).

B. T. Jensen and S. A. Insel, 'Transfer Effects in Spelling', *California Journal of Educational Research*, vol. vi, no. 5, November 1955, pp. 219-23: 'there has been shown to be no negative effect of seeing a word spelled incorrectly'.

Most difficult of all the factors to control in mental and scholastic testing are the efforts of the pupils. The conditions of testing may themselves import bias into the situation, thus vitiating the results. Teachers affirm that certain pupils do not do themselves justice in examinations, but on investigation it was found that, if this is so, the teachers are incapable of indicating correctly which pupils suffer from examination fright. Previous to an examination teachers were instructed to submit a list of the candidates in order of merit, indicating by an asterisk those who were likely to be affected adversely by examination conditions. Comparison of the candidates so designated with the relative order in the examination itself revealed that the teachers' forebodings were not substantiated.[2] A more carefully controlled experiment [3] has shown that when pupils are classified by means of a suitable questionnaire into 'high tension' and 'low tension', although high tensions do not necessarily accompany low examination scores, nor contrariwise, the predictability of the examination score is less with the high tension than with the low tension pupils.

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[1] As used by the Scottish Council for Research in Education in the Scholastic Survey Test, 1953.

[2] *Examination Inquiry — Two Aspects* (The Scottish Council for Research in Education Supplement No. 7 to the *Scottish Educational Journal*, May 1932).

[3] J. T. Hastings, 'Tensions and School Achievement Examinations', *Journal of Experimental Education*, vol. xii, March 1944, no. 3, pp. 143-64.

Apart from the general conditions of testing, the pupils' efforts may fluctuate from test to test for reasons of which the pupil himself is unaware and for which it is difficult to account.[1] Testing assumes adequate motivation but to ensure this is difficult and the influence of incentives on the pupils' output may vary. In equivalent group tests of intelligence set at weekly intervals there may be as great a variation as twenty points of I.Q.[2]

A statistical criterion has been established by which function fluctuation, as distinct from test unreliability, can be detected and the amount due to this factor estimated.[3] Its application to the usual school subjects might help to explain some of the vagaries of the efforts of pupils. In his early article in 'The Measurement of Educational Products' (1918) Thorndike directed attention to such disturbing factors 'notably unfair preparation for the test, inequalities in interests and effort, and inequalities in understanding what the task is'.

Almost contemporary with the mental test another type of measuring device was introduced by Thorndike,[4] namely, a graphometer or scale by means of which the quality of a specimen of handwriting could be estimated with comparative accuracy. Thorndike's scale was the result of some twenty thousand ratings,[1] the differences between successive steps in the scale being equal in the sense of being called equal by competent judges; the principle might be regarded as an extension of the 'method of just perceptible difference' which experimental psychologists had earlier exploited. Although Thorndike concedes [2] that 'observers will disagree in the measurements made with the scale, but not nearly so much as in measurements made without it', its value has been demonstrated repeatedly for various purposes.

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[1] 'The score of an individual in a test should not be considered as a measure of his ability but as a record of his performance under the particular conditions under which the test was given. Judgments as to ability are always inferences from performance and the greater the number of trials or tests from which ability is inferred, the greater the probable correctness of the inference' (*Journal of Educational Research*, vol. iv, no. 1, June 1921, p. 79).

[2] Cf. H. McRae, 'The Inconstancy of Group Test I.Qs.', *British Journal of Educational Psychology*, vol. xii, pt. 1, February 1942, pp. 59-70.

[3] R. H. Thouless, 'Test Unreliability and Function Fluctuation', *British Journal of Psychology*, vol. xxvi, pt. 4, April 1936, pp. 325-43.

C. C. Anderson, 'Function Fluctuation', *The British Journal of Psychology*, Monograph Supplement, xxx, 1958.

[4] E. L. Thorndike, 'Handwriting', *Teachers College Record*, vol. xi, no. 2, March 1910. 'The Thorndike Scale for the measurement of merit in

Thorndike's scale was a scale of general merit. To enhance objectivity in an assessment Ayres prepared a specialised scale based on legibility alone,[3] the degree of legibility being determined by the rate of reading by ten paid investigators of 1578 samples of the handwriting of children of the upper elementary grades of forty school systems. But what Ayres's scale gained in reliability by isolating and assessing one factor — legibility — it lost in validity in comparison with Thorndike's 'general merit' scale.[4] If, for purposes of assessment, handwriting is to

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handwriting was presented before Section L of the American Association for the Advancement of Science at its Boston meeting in December 1909, and was published in the *Teachers College Record* the following March. The construction of the scale . . . marks the real beginning of the scientific measurement of educational products' (*The Seventeenth Yearbook of the National Society for the Study of Education*, pt. ii, p. 12).

[1] For Scale A by 23-55 judges, and for Scale C by 42-91 judges. 'The term "scale" should be applied only to tests or material graded in difficulty or quality, and used to measure degree of difficulty or quality' (*Journal of Educational Research*, vol. iv, no. 1, June 1921, p. 79).

[2] P. 44.

[3] L. P. Ayres, *A Scale for Measuring the Quality of Handwriting of School Children* (New York: Russell Sage Foundation Publication No. 113, 1912).

[4] 'Two of the most important types of problems in measurement are those connected with the determination of what a test measures, and how consistently it measures. The first should be called the problem of validity, the second, the problem of reliability' (*Journal of Educational Research*, vol. iv, no. 1, June 1921, p. 80).

be analysed into factors, a satisfactory scale must include all the factors, not legibility alone. This, Freeman[1] recognised in the charts prepared by him, by grading writing in respect to uniformity of slant, of alignment, of quality of line, of letter formation, and of spacing. To the samples reproduced in the charts illustrating differences in respect to these basic characteristics numerical designations were assigned, and thus an analytic scale was secured. An analytic scale has a similar advantage in regard to objective marking over the general merit or general impression scale as standardised testing has over traditional marking; it can likewise serve better for diagnosing defects, the purpose for which Freeman originally devised it.

There is a vital relationship between testing and teaching. Testing by means of an analytic scale, by emphasising the various factors in an educational process, will give direction to teaching; thus an analytic scale in English composition by isolating vocabulary, sentence structure, linkages, and so on, will induce teachers of English to concentrate on these factors *seriatim* instead of merely instructing pupils to 'do better next time'. It will be objected that the whole is more than the sum of the parts, but the consistency secured by evaluating the parts individually more than compensates for any loss resulting from the neglect of the whole as a whole. By weighting the different factors according to the importance of their contribution to the whole the correspondence between the sum of the parts and the total mark may be increased, but the improvement resulting from weighting should be assessed to see if it justifies the labour involved. The weighting, it may be added, may vary at different stages of the pupil's development. For the pupil the introduction of analytic marking is a gain, for he can infer the omission or defect for which he is penalised instead of relying on his powers of insight into the examiner's mind to discover the justification for a deduction of marks.[1]

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[1] F. N. Freeman, *The Teaching of Handwriting* (Boston: Houghton Mifflin Co., 1914), chap. v and Appendix.

Once standardised tests and scales of measurement are available norms [2] of performance can be obtained. A norm is not necessarily an average. For example, in arithmetic or in spelling the norm might be 100 per cent accuracy. An improvement in the derivation of norms deduced from a study of 'Age and Progress Factors in Test Norms' [3] would be to restrict the selection of pupils participating in an investigation to those only who are 'at age' for their grade or class. But the improvement in standardisation thus obtained is secured only at the cost of sacrificing knowledge of the range of distribution.

This is a great advance as far as stabilising the meaning of a 'grade norm' goes, but it does not afford any criterion of performance for the pupil who is not placed at age for grade. The exceptional pupils are omitted not only from the establishment of norms but also from the determination of variability. But as a criterion for appraising the progress of individual pupils who are not 'at age for grades', the variability of an unselected group is exactly what we need to have. Selection of those at age for grade may eliminate from the standardisation data from a quarter to a half of the total number of children.[4]

[1] McCall in *Measurement*, p. 18, states: 'Scales for the measurement of composition are useful but scales for the measurement of the elements which go to make up composition are also useful. Teachers not only teach children "all over"; they teach them in detail. If tests are to aid instruction effectively, there is as much need for them to measure in detail as in totality.'

[2] The Report of the Standardisation Committee of the National Association of Directors of Educational Research (*Journal of Educational Research*, vol. iv, no. 1, June 1921, p. 79) sought to define the terms 'standard' and 'norm' thus: 'The term "standard" should be applied to scores as an adjective, and only when the scores are set up as goals or objectives or teaching effort. . . . A score representing an actual performance of a group should be called a "norm".' The term 'norm' now tends to be used as a standard or goal or as a criterion.

[3] J. R. Crawford, *University of Iowa Studies in Education*, vol. ix, no. 4, 15 June 1934.

[4] Ethel L. Cornell, 'The Development and Application of Age Progress Percentile Norms of Elementary School Achievement', *Journal of Experimental Education*, vol. 12, no. 3, March 1944, p. 202.

Norms should accordingly be established 'only after a careful study of the effects of variation of each of the factors of age, grade, time of year, heredity, maturity, training and social status', and when a norm is stated the conditions under which it is valid should be clearly defined. With improved teaching practices norms may even be raised from time to time. Norms are useful for comparing the work of a school with what is expected in a school system, for comparing class with class, and for assisting a pupil to assess his standing relative to his fellow pupils. It must be conceded that an educational experiment can have no higher degree of accuracy than the instruments of measurement allow. But the cure for deficiencies in design or in the instruments employed in educational investigation is not to abate or abandon experiment but to initiate and prosecute further experiments, devising and fashioning means which will not only result in increased practical outcomes but will also more adequately satisfy methodological requirements.

CHAPTER V

PLANNING THE EXPERIMENT[1]

THE technique of educational experiment has gradually evolved by the criticism of, and through the disclosure of defects in, investigations undertaken from time to time, and by the adoption of procedures — statistical and otherwise — employed in studies in other fields of inquiry. As problems originating in wider fields of education were proposed for experimental investigation, new or modified methods appropriate to the data and to the instruments of measurement had also to be devised. A body of rules for the planning of educational experiments has thereby been assembled. To ignore the technique thus established is to court disappointment. Too frequently one finds that after the accumulation of data at the cost of considerable time and trouble the point at issue cannot be decided because some essential precaution has been neglected. A slight rearrangement, had it been foreseen at the outset of the investigation, would in many cases have added considerably to the value of the results. Nothing in fact will better repay the investigator than careful planning of the experiment.

Nature may on occasion provide a perfect set-up for an experiment without the intervention of the investigator, on whom it then devolves merely to observe the facts accurately and to report the results precisely. For example, an eclipse may enable a novel hypothesis regarding the structure of the whole physical universe to be verified. Blindness or deafness in pupils presents problems to the educator, and from a study of the life of Helen Keller new facts regarding learning may be gleaned. Colour-blindness, which handicaps boys mostly, but for which girls also should be tested, may serve as a warning against too hasty assumptions as to the pupil's perceptual experience. Left-eyed dominance may create reading disabilities.[1] Careful study of such natural experiments and comparisons with normal functioning may help to disclose problems which might otherwise not be recognised, or, if recognised, not be subject to experimental treatment. We cannot, however, rely solely on natural experiments for the discovery and diffusion of improved practices in education. Instead of awaiting such events we must improvise the situation and organise the means to its elucidation.

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[1] R. A. Fisher, *The Design of Experiments* (Edinburgh: Oliver & Boyd, 2nd edition, 1937).

R. A. Fisher, *Statistical Methods for Research Workers* (Edinburgh: Oliver & Boyd, 9th edition, 1944).

E. F. Lindquist, *Statistical Analysis in Educational Research* (Boston: Houghton Mifflin Company, 1940).

E. F. Lindquist, *Design and Analysis of Experiments in Psychology and Education* (Boston: Houghton Mifflin Company, 1953).

When experiment was first introduced into education it was natural to take as a pattern the physical sciences, a sphere in which the experimental method had been singularly successful. The ideal of these sciences was 'the single variable',[2] which requires that conditions must be exact in every respect save that to be tested. This is the second of Mill's Experimental Methods.[3] Mill himself admits that the method of difference 'is more particularly a method of artificial experiment'. It is coming to be recognised that to isolate the various factors and keep constant all but the one under observation is a totally impossible requirement in educational experiment and in most other social sciences where the data are highly complex and unstable.

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[1] A. M. Macmeeken, *Developmental Aphasia in Educationally Retarded Children.* Publications of the W. H. Ross Foundation (Scotland) for the Study of Prevention of Blindness, ii (London: University of London Press Ltd., 1942).

[2] 'The movement for the use of measurement in education has had for its goal the attainment of uniformity and certainty of interpretation. . . . To aid in bringing about improvement, makers of tests should be careful to investigate the effect of every factor involved in standardisation, conforming so far as possible to the law of the single variable' (*Journal of Educational Research*, vol. iv, no. 1, June 1921, p. 80).

[3] J. S. Mill, *A System of Logic*, Bk. IV, chap. viii. Quoted above in Chapter II.

Various expedients have been adopted to satisfy Mill's canon. It was commonly, although erroneously, assumed that some special value resided in results derived from large numbers of instances even though these had been collected in a somewhat haphazard fashion, that in the long run irrelevancies would cancel one another out, whereas they are just as likely to be cumulative in their effect and thus vitiate any conclusion drawn from them; increase in the number of instances may merely result in increased heterogeneity.[1] On the other hand one fully authenticated instance is sufficient to justify a scientific law, additional instances serving only to confirm the original deduction.

In an effort to approximate to the ideal of the single variable the device of parallel groups, one to serve as a control to the modified group, was early introduced into educational experiments.[2] This involved matching pupil against pupil on some selected basis — chronological age, mental age, scholastic achievement, social status, etc. The difficulty encountered here is that if groups were equated on the basis of chronological age the pupils constituting the groups might differ in intelligence, educational progress or in social status; if different school classes were drawn on to constitute the groups the almost insurmountable difficulty of assessing the influence of the respective teachers obtrudes itself. It is clear, then, that all the factors cannot be adequately controlled at the same time. Fisher[1] has noted that since brothers and sisters tend to be alike in stature, sisters provide a better 'control' for their brothers than do unrelated women, consequently the sex difference could be more accurately estimated from the comparison of each brother with his own sister. Despairing of selecting adequately matched pupils we might impose further conditions and restrict the choice to identical twins,[2] only to be met with the objection that one twin might be right dominant, finding school work easy, while the other was left dominant in hand and eye, handicapped thereby to such an extent in school work as to be rated a problem case.[3]

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[1] Cf. B. O. Smith, *Logical Aspects of Educational Measurement*, p. 61: 'No amount of mathematical subtlety or statistical manipulation will render unreliable data trustworthy'.

[2] For one of its earliest applications see W. H. Winch, *Inductive versus Deductive Methods of Teaching: An Experimental Research* (Baltimore: Warwick and York, Inc., 1913).

A device applied in the hope of cancelling out differences is rotation. McCall[4] maintains that it enables lesson differences, test differences, etc., to be equalised and that it is also of value in eliminating special irrelevant factors such as the skill of the teacher and differences in ability in groups; he likewise claims that it is particularly useful in attacking experimental problems insoluble by other methods. It is really an early, though only partial, realisation of the necessity of randomisation in experimental design. It was employed thus in an attempt to determine the order of difficulty of the hundred addition facts. The combinations were first randomised; convenience dictated that they were best arranged in ten rows of ten combinations each. To minimise the effects of initial spurt, fatigue and other influences characteristic of the work curve, the sheets were so arranged that the first pupil started at the first line, the second at the second, and so on, the tenth pupil beginning at the tenth; the eleventh pupil again begins at the first line. This arrangement also reduces the opportunity of copying by pupils, an additional precaution in class experiments.

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[1] *Statistical Methods for Research Workers* (9th edn.), p. 117. See also *The Design of Experiments*, chap. iii.

[2] Cf. L. H. C. Tippett, *Statistics*, p. 104.

[3] *The British Medical Journal*, 11 February 1956, p. 33, reports monozygotic twins, one of whom was normal and the other a microcephalic idiot.

[4] *How to Experiment in Education* (The Macmillan Co., 1930), pp. 19, 32, 36.

The conclusion so far reached is that the greater the refinements introduced to satisfy the conditions of the single variable the smaller will be the number of subjects available for testing whereas the statistical procedures which have hitherto been generally exploited necessitate large numbers of subjects normally distributed. A further objection to the various designs of experiments in education which have been evolved to satisfy the ideal of the single variable is that the statistical procedures generally applied to them imply the random sampling of the population studied, a requirement seldom observed.

If we adhere to the technique of the single variable and attempt to investigate the effect of age, sex, intelligence, etc., on a specific method of learning, a series of investigations would require to be devised to assess the significance of each factor, and even then the interaction of the various factors would escape detection.

We must also concede that as the social sciences have human beings as subjects, the experimental situation cannot be manipulated to the same extent as in the physical sciences. Control, it has been suggested,[1] can nevertheless be exercised in some degree by the *selection* of certain individuals or classes for observation, and by the matching or grouping of these. The experimenter is here an observer rather than an active agent as in a physical experiment. The resulting experimental design has been defined as 'a form of controlled operation by the agency of selective control of conditions which for purposes of observation it is desirable to hold constant'.

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[1] F. S. Chapin, *Experimental Design in Sociological Research* (New York and London: Harper & Brothers, 1947), p. 29.

Fisher [1] has dismissed the single variable technique in the following terms:

> In exposition of the scientific use of experimentation it is frequent to find an excessive stress laid on the importance of varying the essential conditions *only one at a time.* . . . It is often supposed, at least for purposes of exposition, that to establish controlled conditions in which all of these factors except one can be held constant, and then to study the effects of the single factor, is the essentially scientific approach to an experimental investigation. . . . By contrast in the state of knowledge or ignorance in which genuine research, intended to advance knowledge, has to be carried on, this simple formula is not very helpful. . . . If the investigator confines his attention to any single factor, we may infer that he is the unfortunate victim of a doctrinaire theory as to how experimentation should proceed, or that the time, material or equipment at his disposal is too limited to allow him to give attention to more than one narrow aspect of his problem.[2]

Any design of experiment or associated statistical technique which ignores variations due to the combination of factors such as teacher and method and appraises only method or teacher independently is manifestly too restricted in scope to advance educational science.

The analogy of the physical sciences has thus apparently brought experiment in education to an impasse; educational data are recalcitrant to treatment by the refined technique demanded by the single variable. Must we, then, abandon all hope of profitable experiment in this field, or should we not as is usual when an argument leads to a *reductio ad absurdum*, question our premises? So obsessed by the ideal of physics as the only sphere where experiment has any validity are some writers on educational measurement that they are prepared to accept the most sceptical conclusions and contend that by reason of methodological inadequacies in its units of measurement education will never acquire scientific status.[1]

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[1] R. A. Fisher, *The Design of Experiments* (Edinburgh: Oliver & Boyd, 6th edn. 1951), pp. 91-2.

[2] E. F. Lindquist, *Statistical Analysis in Educational Research*, chap. iv, pp. 78-84, has subjected to critical examination a series of designs hitherto extensively exploited in educational investigation and indicated their respective shortcomings.

As the analogy of physics has proved hopelessly misleading, may not a technique borrowed from other sciences, for example, the biological or agricultural, afford a sound and verifiable procedure and promise better returns?

It is just here that the design of experiment introduced by Fisher for biological and agricultural data comes to the rescue.[2] Instead of attempting the impossible and trying to equalise all the conditions but one, as in the single variable type of experiment, Fisher has inverted the situation and made variability or heterogeneity the basis of his new design. Bias is avoided not by equating all the conditions but one, but rather by *randomisation*; schools or classes are selected at random, teachers assigned at random to the methods under investigation, and so on. It is also essential in the new design to estimate the experimental error involved, and this is effected by '*replication*'; the experiment is repeated in different classes, and the 'error' decreases in size as the number of replications increase. If an investigation is so conducted that no valid estimate of error is available, that is, if we cannot be sure, as in a poorly planned experiment, that the same result might not be obtained by chance, Fisher would deny to it the title 'experiment';[1] the result should be added, he contends, 'merely to the body of experience on which for lack of any better, we may have to base our opinions'.

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[1] See above, Chapter III. Cf., however, C. Bühler and H. Hetzer, *Testing Children's Development* (London: Allen & Unwin Ltd., 1935), chap. ii: 'Under no circumstances should we attempt to obtain a purely mechanical similarity such as the physicist creates when he performs his experiments under the same physical conditions. We should, however, attempt to create a similarity which is adequate in our particular problem. . . . We do not try to obtain objective identity of experimental conditions but functional similarity — that is, a similarity of stimulation for each individual.'

[2] R. A. Fisher, *The Design of Experiments.*
G. W. Snedecor, *Statistical Methods applied to Experiment in Agriculture and Biology* (Iowa: Collegiate Press, Inc., 2nd edition, 1938).
In educational experimentation schools or classes as wholes are regarded as equivalent to the 'plots' in agricultural experiments to which the various 'treatments' are applied.

In addition to randomising all the factors in an experiment we can adopt a design not only to test the effect of treatments and of their interaction but also to test at the same time the effect of certain variations which we introduce into the procedure. Thus, in an inquiry to decide the relative efficiency of two teaching methods, if we suspect that one method might be more efficient with younger or less intelligent pupils, the other with older or more intelligent pupils, we can in planning the experiment, arrange to *control* the age or intelligence factor by matching pupils participating in respect to age or intelligence.

This experimental arrangement enables comparisons of several factors and their possible interactions to be made in one and the same set-up.[2] It has also the advantage over the single variable type in that the structure of the experiment does not restrict us to the decision of one issue at a time. The complexity of the experiment does not affect its precision; it merely increases the amount of statistical computation required. 'Indeed in a wide class of cases an experimental investigation, at the same time, as it is made more comprehensive, may also be made more efficient, if by more efficient we mean that more knowledge and a higher degree of precision are obtainable by the same number of observations.'[3]

Certain variations in the Fisher technique can be introduced. Lindquist has distinguished six varieties and classified designs for educational experiments accordingly.[1]

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[1] *The Design of Experiments*, p. 39.

[2] *Ibid.* chap. vi.

[3] *Ibid.* p. 102.

Of the Fisher technique Lindquist says,[2] it 'represents one of the most important contributions that has yet been made to the techniques of experimental research. It has thus far scarcely been utilised in educational research, and its possibilities are just beginning to be appreciated. It seems destined, however, soon to become the standard procedure in experiments of the general type here considered.' [3]

The techniques of inquiry in education can also be classified according to the time factor involved — the present, the past, the future.[4] By the procedure of selective control, comparisons can be instituted at a given point in time; this is termed cross-section design, and may be illustrated by comparison of pupils' attainments according to size of school class. As conditions might change with the passage of time, it is advisable that cross-sectional investigations should be repeated at different intervals to decide whether the results are concordant.

Instead of planning an investigation *ab novo*, in a retrospective inquiry or an *ex post facto* experimental design, we can regard the present situation as an effect of factors operating at an earlier date and attempt to explain by these the differences now existing. Examples of this design comprise an analysis of the attainments of pupils who have entered school at different ages,[1] or of pupils who have been taught by different methods.[2] The disadvantage of this type of experimental design is that we have to take the facts as we find them and these are seldom arranged just to our liking.

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[1] *Design and Analysis of Experiments in Psychology and Education*, pp. 7-8. For simpler account see his *Statistical Analysis in Educational Research*, chap. iv, pp. 84-6 and chap. v.

[2] *Statistical Analysis in Educational Research*, pp. 84-5.

[3] In Appendix IV of the new and revised (4th) edition of *The Young Delinquent* Burt, dealing with the 'Methods' of investigation, includes the Analysis of Variance and concludes his footnote (p. 641) with the sentence: 'But, with suitably planned investigations, it yields results obtainable by no other technique'.

For application of the experimental design outlined above see 'Experimental Inquiries into the Use of Essay-Type English Papers', by D. A. Pidgeon and A. Yates, *Brit. Jr. Educ. Psych.*, vol. xxvii, pt. 1, February 1957, pp. 37-47.

[4] See Chapin, chap. 2.

In a prospective inquiry, or 'projected design' as Chapin designates it, we have the planning in our own hands from the outset; by it we attempt to measure the relative influence at some future date of modification which we introduce into the present situation. We may start, for example, by teaching one set of pupils by the inductive method and another set — matched for age, intelligence, etc. — by the deductive method, and after a given time determine which of the two procedures has proved the more efficient.[3] All follow-up investigations are of this type.

Experiments in education have also been classified[4] into laboratory experimentation, classroom experimentation and case study. The classroom is undoubtedly the place *par excellence* for educational experiment, for it is here that it is intended to apply the results, and it is advisable that the conditions of investigation should approximate as closely as possible to the regular classroom situations. Experiments necessitating elaborate apparatus may have to be conducted in a psychological or educational laboratory, and in the early stages of the development of experimental education most experiments were conducted in psychological laboratories.[1] The results of this type of experiment may nevertheless not be applicable to school practice without considerable modification. Case study [2] centres on the situation as the unit of attention rather than on the individual as such. But this procedure is likely only indirectly to afford principles of general application. Just as planning has come to acquire increased importance in the solution or amelioration of social problems so it may come to figure more prominently in educational experiment. Nothing but good can result from additional attention to an aspect of educational experiment which has hitherto been somewhat neglected in comparison with that of statistical manipulation.

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[1] See below, Chapter VII.

[2] 'The Relative Methods of Teaching Subtraction', *Studies in Arithmetic*, vol. ii. Publications of The Scottish Council for Research in Education, no. xviii (University of London Press, 1941), pp. 21-70.

[3] Cf. Chapter X below.

[4] *The Thirty-Seventh Yearbook of the National Society for the Study of Education*, pt. ii — The Scientific Movement in Education. Bloomington, Ill. (Public School Publishing Company, 1938). Section ii, chaps. xxv, xxvi, xxvii.

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[1] Cf., for example, E. Meumann, *Vorlesungen zur Einführung in die experimentelle Pädagogik* (Leipzig: Wilhelm Engelmann, 2nd edition, 3 vols., 1911).

[2] Cf. Carter V. Good, 'The Sequence of Steps in Case Study and Case Work', *Educational Research Bulletin*, vol. xxi, no. 6, 16 September 1942 (Ohio State University), pp. 161-71.

CHAPTER VI

BUILDINGS AND EQUIPMENT

Good work has been done by teachers in very adverse circumstances, as even the Hedge Schools in Ireland [1] have testified, but better work can be done when adequate and appropriate facilities are provided. However inadequate functional fulfilment is as an explanation or as an ideal of artistic creation and aesthetic appreciation it must be conceded that the first essential of a school building is satisfactorily to fulfil its function. The school like the factory must be planned functionally as well as aesthetically.[2] In a school including physical training in the curriculum provision must be made for a gymnasium ; if the school is co-educational it might be advisable to provide two gymnasia, one for boys and one for girls, when physical training is taken by both sexes at the same time. Where one gymnasium just suffices for a school devoting one period a week to physical training for each class, two gymnasia would be required if the number of periods were doubled, and so on. Thus if the architect is not to determine the curriculum and decide the child's education, his plans must be adapted to the course of study pursued in the school.

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[1] J. Dowling, *The Hedge Schools of Ireland* (Dublin and Cork: The Talbot Press Ltd., 1933).

[2] Cf. Herbert Read, *Education Through Art* (London: Faber & Faber, 1943), p. 212: 'From the very beginning the aesthetic principle must be applied to the building of the school and its decoration, to every item of its furniture and utensils, to all the organised aspects of work and play'. P. 213: 'The desire to make beautiful things must be stronger than the desire to make useful things, or rather, there must be an instinctive realisation of the fact that beauty and ability, each in its highest degree, cannot be conserved separately'.

To effect the utmost economy in school buildings it is likewise advisable to arrange that the school plant should be put to its maximum use. Thus when pupils are engaged in the gymnasium two or three periods a week their class places may be unoccupied; these places may also be vacant when the same pupils are participating in handwork or domestic science. To secure an intensive use of the school plant the Gary Plan,[1] by designing an arrangement of school buildings, effected a reorganisation of educational facilities. Instead of providing forty classrooms, as under the traditional arrangement, the Gary Plan made provision for only twenty classrooms to accommodate 1600 pupils, the saving thus effected allowing for playing fields, workshops, cinema rooms, etc., on an unprecedented scale; 'the twenty classrooms apparently saved have been replaced by special facilities of one kind or another under an organisation that uses both simultaneously'. The 'duplicate' school, as the arrangement is commonly called, ensures that pupils devote at least half their school time to practical or communal activities.

If, however, a school adopts individual instruction in place of collective teaching, introducing, for example, the Dalton Plan, subject rooms or laboratories must be substituted for classrooms, and for the most efficient arrangement of these rooms it would be advisable to institute a motion study of selected pupils for typical school days. And if the social consciousness of the community has been thoroughly awakened by the disclosures of war-time evacuation, baths should be included in the planning of a school as they were in some schools in Germany over forty years ago. Thus changes in curricula and school organisation present problems to the architect and demand controlled experimentation.[1]

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[1] A. Flexnor and F. P. Bachman, *The Gary Schools: A General Account* (New York: General Education Board, 1918).

The heating, lighting and ventilation of school buildings have also been studied.[2] These are important conditions affecting not only the health but also the learning efficiency of the pupils, and the standard set should be at least as high as that set to secure the maximum output in factories.

The value of equipment or apparatus depends on providing the right material in the right hands at the right time. Of the numerous items of apparatus [3] in the schoolroom the blackboard, by reason of its almost universal use, naturally claimed attention.[4] The brightness difference between letters and background is probably the major factor in determining ease of reading the blackboard, but the problem is complicated by the fact that in copying from the blackboard the pupil is repeatedly effecting a transition from white letters on a black ground to black writing on a white paper. The result of the investigations in both laboratory and classroom experiments was that an appreciable saving in time of copying [5] and presumably in strain is obtainable by substituting a light yellow board for the standard blackboard and using a blue chalk.

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[1] Cf. Ministry of Works, *Post-War Building Studies*. No. 2, Standard Construction for Schools. No. 21, School Buildings for Scotland. (H.M.S.O., 1943/1944.)

J. A. Godfrey and R. C. Cleary, *School Design and Construction* (Architectural Press, 1953).

[2] John Sargent and A. H. Seymour, *School Buildings* (London: National Union of Teachers, 1932). P. E. Nelbach, 'Modern Performance Standards for School Heating and Ventilation', *American Journal of Public Health*, cxii, January 1946, pp. 37-9. *Lighting Schoolrooms*, U.S. Office of Education, Pamphlet 104 (Washington, D.C.: Government Printing Office, 1948), pp. 1-17. Illuminating Engineering Society and American Institute of Architects, *American Standard Practice for School Lighting* (New York: Illuminating Engineering Society, 1948).

[3] It has been suggested that the term *equipment* should be limited to fixed and movable furnishings having a normal life of more than two years and *apparatus* for anything used in the school for instructional purposes, such as maps, charts, etc. *Encyclopaedia of Educational Research*, revised edition, p. 1103.

[4] W. D. Seymour, *Improving the Blackboard* (London: National Institute of Industrial Psychology, 1937).

[5] *Ibid.* p. 30.

The comparative effectiveness of various projection devices used for group instruction — the sound motion picture, the silent motion picture, the silent film slide and the sound film slide, has also been studied.[1] The problem is to determine differences in the instructional outcomes for the media used and the degree to which the differences are significant rather than to determine whether pictorial aids are effective in teaching. Goodman's investigation is a model of careful planning and accurate statistical computation. Film slides, sound and silent, compare favourably with the silent motion picture, and in all instances but one in this experiment are superior to the sound motion picture, which, the investigator suggests, has had an undue emphasis placed upon it and its value in the classroom too readily assumed. The silent motion picture is the single most effective medium, the silent and sound film slides coming very close behind, but by reason of the difference in cost of projector and films and the convenience of manipulation of the film slide, more attention and recognition might be given to the film strip as a teaching tool.

As a general rule the simpler form of apparatus is to be preferred to the more elaborate. Thus from 'Experimental Studies in the Use of Audio-Visual Aids in Vocational Agriculture'[2] it has been concluded that when time is consumed in providing visual experiences the student does not need, there may be a reduction in the efficiency of learning and that learning is not always enhanced by the use of audio-visual aids.

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[1] David J. Goodman, 'Comparative Effectiveness of Pictorial Teaching Aids: An Experimental Investigation in Safety Education at the Elementary School Level', *The Journal of Experimental Education*, vol. xii, no. 1, September 1943, pp. 20-5.

[2] R. R. Bentley, *The Journal of Experimental Education*, vol. xxiv, March 1956, no. 3, pp. 211-20.

A proposal[1] has been made to conduct an experiment to ascertain the most suitable type of pencil for infant pupils. The uncritical acceptance of the practice of providing the child with a pencil of the same length, thickness, etc., as that ordinarily used by the adult has only to be challenged to impress on one the need for investigation; a child would not be given a full-size golf club. The whole range of school equipment evidently invites the attention of the experimenter, both in regard to its suitability for the school child and its effectiveness as a means of instruction.[2]

The extensive use of printed material in school instruction demands that the size and type of print should be appropriate. This has been dealt with very exhaustively in 'A Psychological Study of Typography'.[3]

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[1] *School Buildings*, p. 29.

[2] *Review of Educational Research*, vol. xxvi, no. 2, April 1956, is wholly devoted to 'Instructional Materials'. It covers the resources available to the classroom teacher.

[3] Cyril Burt, W. J. Cooper and J. L. Martin, *The British Journal of Statistical Psychology*, vol. viii, pt. 1, May 1955, pp. 29-57. Also Cyril Burt, *A Psychological Study of Typography* (Cambridge University Press, 1959).

CHAPTER VII

SCHOOL ORGANISATION

If we assume that children are more efficiently educated at school than privately at home,[1] the issue which immediately confronts us is the age at which schooling should commence.[2] This was indeed one of the earliest questions subjected to experimental treatment in education.

Medical opinion has generally been adverse to early, sometimes even to any, entrance to school, and the prognosis has been formulated in the most harrowing terms. We are warned:[3] 'Entrance to school stops or slows down the growth of the child. Its sedentary life, bad air and mental strain, destroys or weakens the appetite and decreases the respiration. Actual counts show a decrease in the number of red blood corpuscles, on which respiration depends. Hence the chemical processes of the body become disarranged; malnutrition with all its attendant evils comes into view. Resistance is lowered; the bacterial blights are given an opportunity. Study shows that all sorts of morbid states increase greatly as the children progress further in school; headaches, nose bleed, eye troubles, insomnia and other nervous disorders become commoner; tuberculosis increases. Further by continued repression of many of the powers, and by forcing activity in powers not yet ready, strain is brought about; spontaneity is done away with; interest in work is destroyed; the instinct of workmanship is rooted out, hate of work cultivated in place of love of it.'

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[1] While education is compulsory in Britain from the age of 5, schooling is not. Thus, Education Act, 1944, 36: 'It shall be the duty of the parent of every child of compulsory school age to cause him to receive efficient full-time education suitable to his age, ability and aptitude, either by regular attendance at school or otherwise'. The Education (Scotland) Act 1946 wording is — 'either by causing him to attend a public school regularly or by other means'.

[2] 'The age of obligatory entrance to elementary schools was fixed as long ago as 1876 at five years', L. A. Selby-Bigge, *The Board of Education* (London: Putnam & Sons, 1934), p. 37.

[3] H. J. Jennings, 'The Biology of Children in Relation to Education', *Suggestions of Modern Science Concerning Education* (New York: The Macmillan Co., 1925), pp. 48-50.

The writer of this indictment concedes that there is no necessity for these detrimental effects, and that the good done by the school may outweigh the evil, but the dangers to physical health by school attendance, when conditions are not all they should be, cannot be ignored.

In 1911 W. H. Winch, a London County Council inspector of schools, published a monograph with the title *When Should a Child Begin School?*[1] The investigation was restricted to pupils whose school life had been passed in the same school, and comparisons were instituted between groups of pupils whose age at entry ranged from 3–3½ years to 5–5½ years. Winch concluded[2] that early entrance, that is, at 3 and 3½ years, confers no intellectual advantage on the child either on his infant school work or in his subsequent progress in school. It is perhaps uncharitable to challenge the conclusions of such a pioneer investigation, but as some of the age-groups comprised as few as four pupils, the means of such small numbers and the correlations calculated from them have doubtful statistical significance; the progress marks were based on reading, spelling, writing, arithmetic, etc., subjects the very early introduction to which might be profitless; the school system of the time was rigid, individual promotion being discountenanced. A repetition of the investigation with the techniques now available might explain what factors were contributing to the results attained.

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[1] Baltimore: Warwick and York, Inc.

[2] P. 94.

From Winch's data it was also evident that late entry to school is a handicap, and that children who enter after the normal age of 5 show some retardation in their subsequent school careers. The failure of late entrants to recover all the lost ground was confirmed by a contemporary investigation in America where the normal age of commencing school is 6. Ayres found[1] that the child who enters at an advanced age subsequently makes more rapid progress than one who enters younger, but not sufficient to enable him to overtake the latter in the school course.

This conclusion has been reinforced by a later investigation.[2] Two studies were undertaken. The first concerned itself with pupils leaving school in 1934 where late entrance was caused by ill health, mental backwardness, or living at too great a distance from school. Their scholastic records showed that a certain amount of leeway was made up in the infant department,[3] but although they remained somewhat longer at school than pupils who entered at the normal age, they recovered approximately only one-half of the original loss. An economy measure in 1932 raising the entering age in New Zealand schools from 5 to 6 afforded an opportunity for a second study. As 5-year-olds were again admitted in 1936, a comparison could be instituted between them and the 6-year-olds entering at the same time under the earlier restrictive legislation. The comparison was made in September 1939. It disclosed that the scholastic achievement of the older entrants in all the subjects tested was superior to that of their 5-year-old fellow pupils who had the same amount of schooling, but was inferior to that of

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[1] L. P. Ayres, *The Relation between Entering Age and Subsequent Progress among School Children* (Russell Sage Foundation Publications, No. 112).

[2] *The Academic Attainment of Late Entrants to Primary School* (The New Zealand Council for Educational Research, Bulletin no. 4, December 1940).

[3] Although their I.Q.s might be the same or even lower, their mental ages would be higher than those of the younger entrants.

5-year-old entrants of the same chronological age.[1]

An inquiry into the relative attainments of American and Scottish pupils supports the earlier entering age in Scotland. American achievement tests were applied to five consecutive age-groups in nine typical schools in the county of Fife.[2] In general level of achievement Fife 11-year-olds were found to be sixteen months ahead of American children of the same age. As the lead established at 11½ years of age is also present at 7½, the advantage of Scottish pupils in educational achievement is attributed mainly to the extra year of schooling, and the conclusion drawn is that the practice customary in Britain of admitting children to school a year or fifteen months earlier than in America appears to be justified on educational grounds.[3]

Additional support for early entrance is afforded by a study on the effect of kindergarten experience upon first-grade readiness and achievement in Pennsylvanian schools where the normal entering age is 6.[4] Three hundred and fifty kindergarten children who commenced kindergarten between the ages of 4 years 7 months and 5 years 7 months, were compared, during and immediately following the first-grade year, with four hundred pupils without kindergarten experience. The study indicated that first-grade children with kindergarten experience were superior to non-kindergarten children in their total or academic readiness for first-grade. There was a significant difference in first-grade number achievement in favour of children with kindergarten experience. When one hundred of each were paired on mental age, the first-grade children who attended kindergarten were not significantly better in reading achievement than those who did not attend kindergarten, while in the case of the larger unpaired kindergarten and non-kindergarten groups, the kindergarten group showed decided superiority. A significant difference in total average achievement of first-graders in favour of children with kindergarten experience was found.

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[1] These findings do not warrant an immediate introduction of formal work to pupils entering at 5.

[2] G. MacGregor, *Achievement Tests in the Primary School*: A Comparative Study with American Tests in Fife. Publications of The Scottish Council for Research in Education, vi (University of London Press, 1934).

[3] For Australian practice regarding entrance to school, see *The Early Years*: A Summary of an Enquiry into age of admission, classification and promotion practices in Australian Primary Schools (Melbourne: The Australian Council for Educational Research, 1957).

[4] M. E. Trusal, 'The Effect of Kindergarten Experience upon Social Readiness and Total Readiness for First Grade and the Effect of Kindergarten Experience upon First Grade Achievement in Reading and Numbers in the Williamsport Public Schools' (*Penn State Review of Educational Research*, vol. vii, no. 1, November 1955, pp. 31-2).

Chronological age is nevertheless a highly unsatisfactory criterion by which to grade pupils as intelligence tests have manifested. Social or psychological factors are more likely to indicate readiness for school, and the significance of these is being investigated by Brenner and Morse at the Merrill-Palmer School, Detroit, Michigan.[1]

At the first exploratory phase of a large-scale longitudinal study of factors predictive of children's readiness for the elementary school, started in 1953, data were collected over an eighteen-month period for a group of sixteen kindergarten pupils. The criterion was the first-grade teacher's rating. The tests, taken six months or more before the teacher's assessment, which proved good predictors, were the pre-school child's knowledge and comprehension of the world in which he lives and his understanding of the meaning of words to describe that world, also his ability to abstract. It is acknowledged that by reason of the small number of children and the unreplicated nature of the study these results must be regarded as merely tentative. The investigation is being extended to the relationship between social- and emotional-maturity indicators and readiness for school, also to classes of pupils other than the private-school participants of the preliminary investigation.

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[1] A. Brenner and N. C. Morse, 'The Measurement of Children's Readiness for School'. Papers of the Michigan Academy of Science, Arts and Letters, vol. xli (Ann Arbor: The University of Michigan Press, 1956, pp. 333-40). P. 340: 'A long-range project to investigate the factors predictive of children's readiness for elementary-school experience was begun in 1953. A preliminary analysis has been made from data collected over an eighteen-month period on a group of sixteen private-school pupils who were studied from the time they entered the kindergarten. The problem investigated was the relationship between one criterion of readiness for school and various measures of the children's maturity. The validating criterion was the teacher's rating of the children on their level of functioning in the first grade. The maturity measures included both physical- and mental-maturity indicators, and were taken six months or more before the teacher's rating. The results suggest that certain measures of mental maturity made at the beginning of the kindergarten year, particularly those evaluating the pre-school child's knowledge of the world in which he lives and his ability to abstract, are good predictors of readiness for school. The small number of children and the unreplicated nature of the analysis mean that at this time the results are only tentative.'

Education and Mental Health[1] cites L. Danzinger, *Wiener Arb. Z. päd. Psychol.*, No. 9, 1933, who, basing her deductions on individual case studies, suggests as essential for readiness for school: a certain level of intellectual development; an ability to engage in purposive work; some sense of duty and capacity to respond to set tasks, to concentrate, persevere and resist distraction; and the power to participate in collective activities and to respond to suggestions and tasks given, not to the child personally, but to the class as a whole.

The effect of age at time of entrance to school has been investigated in Alberta,[2] the conclusion arrived at being that a combination of chronological and mental age is desirable in entrance regulations, chronological age since some children of low mental ability would not enter till they were 7 or 8 years of age, and a minimum mental age unless an extremely differentiated programme is provided to meet the wide range of abilities encountered among pupils entering school.

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[1] Edited by W. D. Wall, UNESCO, Harrap, 1955, p. 108.

[2] W. G. Bevington, 'Effect of Age at Time of Entrance to Grade I on Subsequent Achievement' (*Alberta Journal of Educational Research*, vol. iv, no. 1, March 1958, pp. 6-16).

If a child has no option but to attend school, what are the relative merits of different sizes of school? By a comparison of the attainments of pupils in city and rural schools [1] it was disclosed that in the rural areas the lowest scores were made by schools of medium size, the highest scores being made by the small schools or the large schools. The explanation hazarded for this difference [2] is that large schools provide the driving force of competition and make careful coaching possible where the teacher has only one class to attend to; small schools allow a good deal of individual attention, even when the teacher has other pupils under her charge, and the unbroken continuity of instruction where a single good teacher is in charge of a child for a number of years, perhaps during his whole primary school career, cannot but be of great advantage; but schools of intermediate size, that is, schools in which a teacher may have two or three classes at different stages, lack both advantages. The 1947 Scottish Mental Survey confirmed that the pupils in the smaller schools suffer no intellectual handicap and that, in general, the children with the highest average test scores appear in the very small and the very large schools.[3] A New Zealand investigation [4] on the policy of consolidation — that is, amalgamating or merging several small (usually primary) schools into one large school or closing small rural schools and transporting pupils to a larger school — suggests that the small school should be retained for children at the primary stage but that consolidated schools are a necessity for children at the intermediate (12–14) and secondary stages.

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[1] A. S. Mowat, *City and Rural Schools*: A Comparison of the 'Qualifying' Candidates (Publications of The Scottish Council for Research in Education, xi, 1938). (Rural schools in Scotland are staffed by trained teachers.)

[2] *Ibid.* p. 66.

[3] *Educational and Other Aspects of the 1947 Scottish Mental Survey* (Publications of the Scottish Council for Research in Education, xli, University of London Press, 1958).

[4] G. W. Parkyn, *The Consolidation of Rural Schools*. New Zealand Council for Educational Research, Educational Research Series, no. 32 (London: Geoffrey Cumberlege, 1952).

The size of class might be thought to be more significant than the size of school. There is an insistent demand on the part of teachers for smaller classes. Only in so far, however, as a reduction in number of pupils admits of the introduction of an improved teaching technique is an increase in efficiency likely to result from the change. There may, in fact, be an optimum size for maximum efficiency — a class that is neither too large nor too small, and reduction below a certain level may be detrimental. The optimum size may likewise vary with the subject — such variation is assumed in official regulations for certain school systems, also with the stage of progress, the age of the pupils and their level of ability. The advantage of the small class might accrue with bright pupils but not with dull pupils or vice versa.

The literature on fifty experiments from 1896 to 1931 on the effect of class size on achievement was reviewed by Dora F. Smith in *Class Size in High School English: Methods and Results.*[1] As the studies were not all made under the same conditions, the conclusions were naturally somewhat inconsistent. Miss Smith nevertheless observed [2] that the measurable results of instruction bore little observable relationship to the size of class in which pupils were taught. Her own investigation concerned ninth-grade [3] English; twenty pupils were taught as a class one year, and twenty-one the following year, and parallel groups of the same number were taught as members of a class of fifty-one. Her results [4] showed that the efficiency of instruction was

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[1] Minneapolis: The University of Minnesota Press, 1931, ch. ii. Cf. J. B. Holland, 'The Image of the Instructor as it is Related to Class Size', *The Journal of Experimental Education*, vol. xxiii, December 1954, no. 2, pp. 171-7.

[2] P. 82.

[3] American grades: Age in years and months at the end of each grade:

Grade	1	2	3	4	5	6	7	8
Age	7^2	8^2	9^4	10^5	11^7	12^7	13^6	14^5

[4] P. 108.

independent of the size of the class in grammar, punctuation, capitalisation, mechanics of reading, and composition exclusive of letter-writing. The small classes were definitely superior in letter-writing and library methods. Large classes were decidedly advantageous for progress in spelling, increase of vocabulary, knowledge of literature, and extent and variety of reading activities, including initiative in unsolicited contributions to classroom projects, amount of voluntary reading, and general spirit and enthusiasm for the work. Although the investigation dealt only with English, the results of studies in mathematics and geometry by her colleagues confirm the opinion that the size of class is not a paramount factor in instructional efficiency.

The latest investigation[1] 'provides no evidence to show that large classes necessarily have a deleterious effect on school attainment'.

The authors of the article on 'Class Size' in the *Encyclopaedia of Educational Research*[2] arrive at much the same result, and conclude: 'Research has barely touched the instructional aspect of class size. As long as rather conventional, routinised group procedures are used in teaching, it is not likely that research will show whether large or small classes are to be preferred.'

The advantages, ease and efficiency of teaching, it is claimed, might accrue with larger classes by homogeneous grouping, that is, by organising into classes pupils with approximately the same intelligence. It might be contended that there is nothing new in homogeneous grouping, that the traditional schools have always applied the principle, the criterion with them being chronological age. All that is new is the substitution of mental, for chronological, age as the basis of classification. But if chronological age resulted in considerable diversity of attainment among pupils in the same class, uniformity of mental age as the basis results in a wide range of chronological age, and this has its dangers in social maladjustments. Pupils of the same mental age are in addition likely to have different I.Q.s, that is, different rates of development; and would very soon be at sixes and sevens again; for pupils with the same mental age but with I.Q.s 120, 90, 60 would at the end of one year have progressed $1\frac{2}{5}$, $\frac{9}{10}$, $\frac{3}{5}$ of a year respectively. Special abilities also obtrude themselves; pupils at an equivalent stage in arithmetic may be at quite different stages in reading ability; reclassification for every subject is thus called for. It is evident that we are encountering here an analogous difficulty to that in equating pupils for experimental purposes. Carried to its logical conclusion homogeneous grouping would necessitate the individualisation of instruction.[1]

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[1] L. C. D. Kemp, 'Environmental and Other Characteristics Determining Attainment in Primary Schools', *Brit. Jr. Educ. Psych.*, vol. xxv, pt. ii, June 1955, pp. 67-77. L. C. D. Kemp, 'Variability in Attainment', *Brit. Jr. Educ. Psych.*, vol. xxvii, pt. iii, November 1957, pp. 211-14.

[2] Revised edition (New York: The Macmillan Co., 1950, pp. 212-15).

Claims are constantly being advanced by members of the lay public for the inclusion in the educational programme of their particular interests regardless usually of the limits set by the length of the school day. Even by members of the teaching profession itself insistent demands for additional time for their own specialities are echoed — at the expense, although usually implied only, of other subjects. While the school day may in certain circumstances be profitably extended, as in the Gary Plan,[2] it behoves educational administrators to budget to the best advantage the time at the school's disposal.

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[1] M. Y. Burr, *A Study of Homogeneous Grouping in Terms of Individual Variations and the Teaching Problem*. (Bureau of Publications, Teachers College, Columbia University, 1931.)

H. S. Wyndham, *Ability Grouping*. Australian Council for Educational Research, Series No. 31. (Melbourne University Press, 1934.)

Thirty-Fifth Yearbook of the National Society for the Study of Education, 1936, pt. i.

Encyclopaedia of Educational Research, Revised Edition, 1950.

[2] See above, Chapter VI.

The facile assumption that the success attendant on the efforts of pupils in school subjects is directly proportionate to the amount of time devoted to the teaching of a subject was challenged in what is generally admitted to be the first statistical inquiry in education in America. Rice [1] in 1897 revealed that the spelling results of children in schools devoting ten minutes were as good as those of schools giving as much as fifty minutes per day to the subject.

Thorndike likewise found that at least three systems devoting about seventy-five minutes a week to writing, obtained results no better than those obtained by two systems devoting no time to it, and from another system allocating the former time to the subject results were about 25 per cent better than the three first mentioned.

Studies in the apportionment of school time [2] have disclosed surprising variations in time allocation even within the same school system, and in view of Rice's early inquiry, it would be hazardous to contend that the maximum times result in the greatest efficiency. Only by controlled studies of the relation of achievement expected and attained to time expended at different stages of the various subjects can optimum times be established. When comparisons are instituted between different countries or between different amounts of time in the same country, the number of days in the school year and the length of school life of pupils should be allowed for.

In planning the daily time-table provision should be made for intermissions. The need for such breaks did not escape those great masters of educational method — the Jesuits. In the *Ratio Studiorum* of 1599 'The Rules for the Scholastics of our Society' decree:[1] 'Let no one apply himself to the toil of reading or writing for more than two hours, but let his study be interrupted by a short interval of time'. Francis Bacon, who in all things educational advises us to consult the schools of the Jesuits, for, as he says, nothing better had been put in practice, repeats in his Essay — 'Of Nature in Man': 'Let not a man force a habit upon himself with a perpetual continuance, but with some intermission. For the pause reinforceth the new onset.' And in *De Augmentis Scientiarum*[2] (1623) he elaborates, 'Exercises, it is obvious, play the principal part in instruction. But few have observed that there ought to be not only a wise choice and course of exercises, but a wise intermission of them also, for it is well observed by Cicero, "that men in their exercises for the most part exercise their faults as well as their faculties", so that an ill habit is sometimes acquired along with the good. It is safer therefore to intermit exercises from time to time, and to return to them after a while, than continually to pursue and press them.'

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[1] J. M. Rice, 'The Futility of the Spelling Grind', *Forum*, April and June 1897.

[2] C. H. Mann, *How Schools Use Their Time*. Time Allotment Practice in 444 cities, including a study of trends from 1826 to 1926 (Bureau of Publications, Teachers College, Columbia University, New York, 1928).

Scottish Primary School Organisation: Age-Grade Classification: Time Allocation to Subjects (Publications of The Scottish Council for Research in Education, xiv, 1939).

To intersperse periods of learning with rest pauses has been found to be beneficial, the work resumed being on a higher level than when it was interrupted. The person who is keen on sport finds that after an enforced period of abstinence his play has not deteriorated as he had feared, but may actually have improved, and the improvement is frequently quite marked. This experience led William James to propound the paradox that we learn to swim during the winter and to skate during the summer.[3] Consideration should accordingly be given to the most profitable length and placing of pauses in the school day and of vacations in the school year.

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[1] E. A. Fitzpatrick, *St. Ignatius and the 'Ratio Studiorum'* (New York and London: McGraw-Hill Book Co., 1933, p. 236).

[2] Chap. iv.

[3] *Principles of Psychology* (London: Macmillan & Co., 1890, vol. i, p. 110).

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CHAPTER VIII

THE CURRICULUM

IDEALLY the curriculum should be deduced from the aim of education, as Herbart attempted, but in practice it is largely determined by tradition, developing by accretion in piece-meal fashion. In *De Augmentis Scientiarum* [1] Bacon included pedagogy as an aspect of the transmission of knowledge in general. The task of education, thus conceived, is to hand on the torch of learning from one generation to the next. The curriculum represents the cultural heritage that is considered worth transmitting. While the child cannot be denied access to the wisdom of the ancients, he cannot be restricted to foregone achievements. As a protest against an exclusive attention to the past some modern curriculum makers [2] would reject all handed-down material and allow the present-day needs of the child or of the adult community to decide the content of the curriculum. There are others [3] for whom the problem of the curriculum is the correct prediction of the future. Thus Truman L. Kelley says, 'The determination of what constitutes an appropriate curriculum is a problem of estimating the future — the issue being what can be done now that will best serve the pupil in the future, immediate or remote'.

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[1] Ellis and Spedding, *The Philosophical Works of Francis Bacon* (London: George Routledge & Sons, 1905, pp. 558-9).

[2] *E.g.* W. H. Kilpatrick, *Remaking the Curriculum* (New York: Newson and Company, 1936).

[3] *E.g.* Truman L. Kelley, *Scientific Method*: Its Function in Research and in Education (Columbus: The Ohio State University Press, 1929), p. 118.

Whether the curriculum is viewed from the standpoint of the past, the present or the future, a scientific determination of the content is important, for on it depend not only the future of the pupils but also the methods of teaching, the planning and equipment of the schools and the training of teachers. The significance of the scientific treatment of the curriculum is, with emphasis on his own standpoint, thus expressed by Truman Kelley: [1]

> I know of no phase of human life of greater import and of greater dependence upon a sound determination of future values than that of curriculum construction. The inclusion of any item in a certain curriculum is a result of the estimate of some person or some group that knowledge of it will have a value in the later lives of the pursuers of the curriculum. When we consider the importance in our lives and in those of our children of elementary, high-school and college curricula, we cannot in sense and reason turn away from this problem of future values with a sneer that it is outside of the realm of science. It certainly is not outside the realm, but if it were, it would be so much the worse for science. Light may be thrown upon it by the best exercise of historical investigation, by innumerable facts revealed by experimental method, and by checks upon the outcome of the soundest forecasts, put into practice, of early years. There is no step in the complete act of thought, including that of experimental verification, that should not be involved in the attack upon this problem.

The approach to the curriculum from the scientific standpoint can either be by way of appraising the attainment of the objectives set, or by way of assessing the attainability of objectives proposed. In the former case, if our purpose is to impart a certain fixed amount of information, our success or failure in achieving this can doubtless without undue difficulty be assessed. If our aim is to train the pupils' minds, the amount of improvement resulting from training could also be reckoned. If, however, by means of the subjects of the curriculum we hope to modify the pupils' personalities, the establishment of a satisfactory criterion might nullify our efforts. On the other hand, if we are required to assay the attainability of certain objectives, we should not only require a diagnosis of the pupils' capacities but also a prognosis of the future state of affairs when the pupils have attained adulthood.

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[1] P. 36.

Instead of testing the influence of the curriculum as a whole we may isolate a specific subject or group of subjects and examine whether the claims advanced on its behalf are justified.

Rousseau [1] prescribed physical exercises for Émile on the supposition that they would improve his intellect: 'Would you cultivate your pupil's intelligence, cultivate the strength it is meant to control . . . make a man of him in strength and he will soon be a man in reason'. And of his ideal savage he asserts: [2] 'Thus the more his body is exercised, the more alert is his mind; his strength and his reason increase together, and each helps to develop the other'. In recent times it has been frequently contended that physical training not only improves the intellectual powers but that it also develops certain moral qualities. This is surely a suitable topic of inquiry, and the issue has been put to the test by F. J. Milverton in 'An Experimental Investigation into the Effects of Physical Training on Personality'.[3]

His aim was to determine whether, as advocates of physical education have contended, such traits as gregariousness, sociability, loyalty, co-operation, etc., were fostered by a proper scheme of physical exercises. Sixteen such traits were collected from the literature on the subject, but the degree of agreement between the assessments of three raters for certain of these traits was so low that it was futile to examine them further. Gregariousness, sociability, co-operation, concentration and initiative remained, and it was found that a gain in concentration alone, outside the physical exercises, resulted from a progressive course of physical exercises whereas a non-progressive course of exercises had no such effect and might even have an adverse influence. He concludes thus :[1]

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[1] *Emile*, Everyman translation, p. 82.

[2] P. 83.

[3] *Brit. Jr. Educ. Psych.*, vol. xiii, pt. 1, 1943, pp. 30-8.

> It follows then that the bulk of the claims made for the effects of physical training on the mental sphere cannot be substantiated by scientific evidence, either because they are not true or because they refer to qualities which cannot be measured satisfactorily, or because they require a longer time for testing than was possible in this experiment.

From this investigation it is evidently not advisable to foreclose the limits of experiment and exclude all reference to values.

In *Testing Results in the Infant School* and *Long Term Results in Infant School Methods*[2] we have a pioneer effort to compare the efficiency of two contrasting infant school curricula — the 'activity' and the 'formal'.[3] The fact that they had so little in common created difficulty in devising tests equitable to both ; the investigation was a retrospective one with the deficiencies incidental to this type of study.[4] The classes compared were not assigned at random, as the modern technique of experiment requires, but chosen from those available. Nevertheless, results obtained indicated that at the age of 10, on tests of concentration, listening and remembering, ingenuity,

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[1] *Brit. Jr. Educ. Psych.*, vol. xiii, pt. 1, 1943, p. 34.

[2] By D. E. M. Gardner (London : Methuen & Co., 1942, 1950).

[3] Cf. T. Percy Nunn, *Education: Its Data and First Principles* (London : E. Arnold & Co., 3rd edition, 1945, p. 263). 'The school must be thought of primarily not as a place where certain knowledge is learnt, but as a place where the young are disciplined in certain forms of activity.'

[4] Matching of pupils appears to have been imperfect, thus

	Activity group	Formal group
Long Term Results : p. 62	278	229
69	216	176

sociability and interests, out of 45 results 27 were in favour or tended to be in favour of the activity group, 13 were insignificant, and 1 was in favour of the formal group.[1] This is not likely to cause surprise, but in the usual scholastic subjects — arithmetic, reading, composition, handwriting and free drawing — out of 40 results there were 24 in favour of the activity group, 15 were insignificant and only 1 in which the formal group was superior. This confirmed the conclusion of the earlier work:[2] 'The results of the research which I have described in this book offer evidence that the teacher of Junior School children has nothing to fear but everything to gain from Infant School methods which made use of the free activities and spontaneous interests of the children'.

With the tests further refined and with the adoption of planning on more scientific lines a repetition of this inquiry into curriculum reconstruction would be a useful contribution to educational practice.

A more ambitious comparison of activity and formal methods with pupils at a later stage of their school career was undertaken in New York during 1937–9.[3] The magnitude of the investigation and the complexity of the procedures adopted may be inferred from the voluminous literature originated by it. Four classes in each of eight activity schools were matched with a similar number of classes in control schools. The pupils participating numbered more than two thousand, and were mainly in grades 4, 5 and 6. New techniques had to be devised and their reliability established. Batteries of tests were also specially prepared for this study.

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[1] *Long Term Results*, p. 106.

[2] *Testing Results*, p. 151.

[3] A. T. Jersild, R. L. Thorndike, B. Goldman, J. J. Loftus, 'An Evaluation of Aspects of the Activity Program in New York City Public Elementary Schools', *Journal of Experimental Education*, viii, December 1939, pp. 166-207.

A. T. Jersild, R. L. Thorndike, B. Goldman, J. W. Wrightstone, J. J. Loftus, 'A Further Comparison of Pupils in "Activity" and "Non-Activity" Schools', *Journal of Experimental Education*, ix, June 1941, pp. 303-9.

S. B. Sells, J. J. Loftus, L. Herbert, 'Evaluative Studies of the Activity Program in the New York City Public Schools: A Preliminary Report', *Journal of Experimental Education*, ix, June 1941, pp. 310-22.

A. T. Jersild, B. Goldman, C. L. Jersild and J. J. Loftus, 'Studies of Elementary School Classes in Action, I, A Comparative Study of the Daily Occupations of Pupils in "Activity" and "Non-Activity" Schools', *Journal of Experimental Education*, ix, June 1941, pp. 295-302. 'II, Pupil Participation and Aspects of Pupil-Teacher Relationships', *Journal of Experimental Education*, x, December 1941, pp. 119-37.

R. L. Thorndike, J. J. Loftus and B. Goldman, 'Observations on the Behaviour of Children in Activity and Control Schools', *Journal of Experimental Education*, x, December 1941, pp. 138-46.

Difficulty was encountered, as in all such investigations, in finding measures common to both activity and control schools. It may be that it is just in the things in which they differ and cannot be measured that the significance of the comparison lies, and that the benefits obtained by the one set of pupils are offset by the advantages gained by their opposite numbers in other aspects. Detailed results in this American study are so numerous and so varied that only a few can be cited. Many of the differences too are not statistically significant. Thus, whereas in reading comprehension and speed the control children were slightly superior, and maintained a substantial advantage over the activity children in arithmetic comprehension and arithmetic reasoning, 'to the extent, however, that an increase in quality of co-operation, and in frequency of performances such as those included under the headings of initiative, experimentation, critical activities and leadership, may be regarded as valuable outcomes *per se*, the observational data indicate that important objectives of the activity program have been achieved to a large degree.' [1] Supplementary findings on critical thinking in the social studies, knowledge of current affairs, social beliefs and attitudes, and personality adjustment for seven activity and seven control schools with from 197 to 216 matched pairs of pupils support the previous conclusions that in academic subject-matter the control pupils have a slight advantage, the activity children surpassing the controls in other presumably wholesome activities.[1]

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[1] *Journal of Experimental Education*, viii, pp. 204, 206.

A further evaluation of the results on one achievement test in relation to the amount of classroom time spent on the study of formal subjects by the activity and control groups respectively suggests that the diversion of part of the class time of the activity programme classes to 'newer practices' was accomplished without significant prejudice to the satisfactory attainment of desired outcomes in the formal subjects, although the time spent amounted to only 70 to 80 per cent of that spent by the controls; also, that the increase in the control group may be due to greater capacity for improvement as a function of greater initial mastery of the material.[2]

The procedure of direct observation on pupil participation revealed that in both the activity and the control groups positive items from the teacher (explicit praise, commendation and the like) occurred considerably less often than did negative items from the teacher (explicit reproof, reprimands and the like). The difference between negative and positive items was, however, greater with the activity than the control group.[3] An outcome of the observational technique in connection with the 'newer' procedures in education is that in encouraging pupils to join with the teacher in planning their work, 'what sometimes seems to happen is that "group decisions" which determine the choice of a given unit of work . . . actually do not reflect the sentiment of the group but are determined by a few children who happen to be very articulate, who establish priority for a certain suggestion, or by sheer volume of talk prevail upon the class as a whole to adopt their proposals'.[4]

In spite of certain differences so large that they could hardly have arisen by chance alone, a further study showed more of similarity than of difference in the pattern of behaviours in the two school situations.[1]

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[1] ix, p. 308.

[2] ix, pp. 320, 322.

[3] x, p. 134.

[4] x, p. 135.

A comparative study of the worries of children in the two school situations disclosed[2] that there were no substantial differences between the worries reported by children in activity and non-activity schools. The situation which the largest percentage of children in both groups reported that they worried about was 'failing a test'. It also appeared that the greater amount of time devoted to other undertakings in the activity schools has not relieved pupils of tensions connected with conventional school subjects like arithmetic, reading and spelling.

Although the conclusions reached in this study merely conform for the most part to *a priori* presuppositions, it has undoubted value for exhaustively exploiting the issues involved in curriculum construction.

An attempt to appraise at the college level the relative merits of the two contrasting systems of education, 'progressive' and 'traditional', based on different curricula is to be found in the report, in five volumes, of the Eight-Year Study of the Progressive Education Associations' Commission on the Relation of School and College.[3]

The technique adopted was[4]

> to establish some just basis of comparison if the work of the graduates of the Thirty Schools was to be judged fairly.

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[1] *Journal of Experimental Education*, x, p. 141.

[2] A. T. Jersild, B. Goldman and J. J. Loftus, 'A Comparative Study of the Worries of Children in Two School Situations', *Journal of Experimental Education*, ix, June 1941, pp. 323-6.

[3] Vol. i: *The Story of the Eight-Year Study*, by Wilford M. Aikin.
Vol. ii: *Exploring the Curriculum*, by H. H. Giles, S. P. McCutchen, and A. N. Zechiel.
Vol. iii: *Appraising and Recording Student Progress*, by Eugene R. Smith, Ralph W. Tyler *et al.*
Vol. iv: *Did They Succeed in College?* by Dean Chamberlain, Enid Straw Chamberlain, Neil E. Drought and William E. Scott.
Vol. v: *Thirty Schools Tell Their Story*.
(Harper and Brothers, New York: 1942.)
Also, James Hemming, *Teach Them to Live* (Heinemann, 1948).

[4] Vol. i: *The Story of the Eight-Year Study*, p. 109.

Since it was expected that they would be somewhat above the average college students in native ability, it would not do to compare their achievement with average performance. Therefore, a basis of comparison was established by matching, with utmost care, each graduate from the Thirty Schools with another student in the same college who had taken the prescribed courses, had graduated from some school not participating in the study, and had met the usual entrance requirements. They were matched on the basis of sex, age, race, scholastic aptitude scores, home and community background, interests and probable future. For example, here is a boy — the son of a lawyer and a graduate of one of the large, public schools in the study — eighteen years of age, from a home and community which afford cultural and economic advantages, unusually able in mathematics and planning to become an engineer. As his 'matchee' the Follow-up Staff selected in the same college a boy, eighteen years of age, who had a similar background, the same vocational interest and scholastic aptitude, but who had met the customary entrance requirements.

The conclusions are summarised thus:[1]

> In the comparison of the 1475 matched pairs, the College Follow-up Staff found that the graduates of the Thirty Schools earned a slightly higher total grade average; earned higher grade averages in all subject fields except foreign language; specialised in the same academic fields as did the comparison students; did not differ from the comparison group in the number of times they were placed on probation; received slightly more academic honors in each year; were more often judged to possess a high degree of intellectual curiosity and drive; were more often judged to be precise, systematic, and objective in their thinking; were more often judged to have developed clear or well-formulated ideas concerning the meaning of education — especially in the first two years in college; more often demonstrated a high degree of resourcefulness in meeting new situations; did not differ from the comparison group in ability to plan their time effectively; had about the same problems of adjustment as the comparison group, but approached their solution with greater effectiveness; participated somewhat more frequently, and more often

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[1] Vol. i, pp. 110-12.

enjoyed appreciative experiences, in the arts; participated more in all organised student groups except religious and 'service' activities; earned in each college year a higher percentage of non-academic honors (officership in organisations, election to managerial societies, athletic insignia, leading roles in dramatic and musical presentations); did not differ from the comparison group in the quality of adjustment to their contemporaries; differed only slightly from the comparison group in the kinds of judgments about their schooling; had a somewhat better orientation towards the choice of a vocation; demonstrated a more active concern for what was going on in the world.

These findings have not gone unchallenged.[1] Lancelot, for example, contended that a large majority of the experimental schools were institutions with programmes so costly that their product could not be fairly compared with that of other schools generally; that because of their ample resources, the assumption was warranted that they employed, within limits, the most capable teachers that were available; that they maintained pupil-teacher ratios much lower than those commonly found in other secondary schools of the country.

Exploring the Curriculum[2] devotes as much attention to teacher development as to curriculum reform; the striking change of attitude required of teachers in the experimental schools to meet the new requirements amounts almost to a conversion. The criticism that success was due to the teachers and not to the curriculum is only half the truth if the changed attitude to their work and the added zest in their labours were themselves the effects of the curriculum reorganisation; it is merely a question of whether the impact of the re-oriented curriculum came directly on the pupils or through the intermediary of the teaching staff.

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[1] W. H. Lancelot, 'A Close-Up of the Eight-Year Study', *School and Society*, 11 December 1943.

W. H. Lancelot, 'The Eight-Year Study Still Awaits Fair Appraisal', *School and Society*, 3 November 1945.

H. G. Johnson, 'Weakness in the Eight-Year Study', *School and Society*, 15 June 1946.

[2] Vol. ii.

The study unfortunately does not fulfil the conditions of a satisfactory experimental design. The pupils were matched only at the end of their courses, at the college stage, instead of being assigned to the respective types of school by random at the outset; teaching skill was not controlled as the teachers were not assigned to the respective schools by random. The co-operation initiated between the schools and the colleges, and the results achieved nevertheless justify the conviction that analogous experiments might with advantage be conducted elsewhere.[1]

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[1] See *Memorandum on Curriculum Research* (Board of Education of the City of New York, 1955).
Review of Educational Research, vol. xxvii, no. 3, June 1957, 'Curriculum Planning and Development'.

CHAPTER IX

EDUCATIONAL METHOD

FROM the earliest times educational method was based on philosophical presuppositions, on analogies from nature or on superficial psychological principles. The Socratic method implied the transmigration of souls, assuming that the individual had passed through a succession of previous existences and in the process had acquired and retained some of the experiences; 'all knowledge' as Plato accordingly said 'is but reminiscence'; the technique adopted to recall this innate knowledge was the dialectic process of critical examination but the Socratic lesson degenerated into a series of futile questions and answers. Pestalozzi, who maintained that knowledge was acquired by experience, by first-hand contact with objects, condemned Socratising as mere verbolatry, and from his time the Socratic method gradually fell into disfavour.

Comenius,[1] by some regarded as the 'true founder of modern method', formulated a series of maxims of method, professing to derive these by analogy from nature. Thus, 'Nature does not proceed *per saltum*, but step by step'; 'Nature proceeds from the more easy to the more difficult'; 'Nature begins all its formation from generals, and thence proceeds to specialise'. Herbert Spencer [2] formulates a similar set of maxims: 'In education we should proceed from the simple to the complex'; 'The development of the mind is an advance from the indefinite to the definite'; 'Our lessons ought to start from the concrete and end in the abstract'. The criticisms passed on any proverbial philosophy apply equally to such a set of pedagogical maxims as those of Comenius or Spencer; as they do not constitute a system, they may contradict one another, and no principle is available to decide which one is applicable in a given situation.

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[1] *E.g.* S. Laurie, *J. A. Comenius* (Cambridge University Press, 1899), p. 256.

[2] *Education: Intellectual, Moral and Physical*, chap. ii (London: Williams & Norgate, 1906).

Herbart insisted that a certain sequence should be followed in the exposition of a topic — the formal steps corresponding to the stages in the growth of knowledge in the mind. Kilpatrick[1] has analysed the purposeful act, into the stages — purpose or select, plan, execute or perform, judge or assess, the procedure adopted by the pupil in devising and completing a project. In this fashion the body of precepts constituting educational method was built up.

The presuppositions underlying such principles of method may be questioned or the analysis on which they are based may be regarded as inadequate or as unsatisfactory; claims in support are countered by contradictory contentions and deadlock ensues. To decide these and other issues in educational method resort must be had to scientifically planned and strictly controlled investigations.

The issue of incidental versus systematic instruction was raised by the earliest investigations into spelling by Rice and Cornman.[2] Their methods were similar and their conclusions in general agreement. From statistical analysis of the errors made by pupils of several different schools when required to write dictated lists of isolated words, of words in sentences, when writing compositions, and in lists of spontaneously written words, they concluded that the degree of general mental development, as measured by the school grade of the pupil, was the most important factor contributing to the accuracy of spelling. Spelling ability is dependent more on the efficiency of the teacher than on the time allotted to the teaching of the subject or on the method employed. Rice maintained that the spelling grind was futile, and Cornman advocated the incidental teaching of the subject.

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[1] *The Foundations of Method* (New York: The Macmillan Co., 1925).

[2] J. M. Rice, 'The Futility of the Spelling Grind', *Forum*, vol. xxiii (1899), pp. 163-72, 409-19.

O. P. Cornman, *Spelling in the Elementary School* (Ginn & Co., 1902).

These inferences were challenged by the immediately succeeding investigations of Wallin in America and Winch in England.[1] Wallin, employing, unlike Cornman, different sets of words for different grades and disregarding the retarded pupils in the various classes, found that spelling proficiency increased with age. He combats the suggestion that the method of instruction does not influence the result, maintaining that his investigation amply demonstrates the superiority of a skilful spelling-drill technique. While he does not despise the influence of motivation arising from the felt need by the pupil of a word which is the essential feature of the incidental method, nothing can contribute to facile control, he maintains, but focalised reiteration. Winch also found that a 'direct' method was for all purposes more profitable than an 'indirect' method.

An experiment[2] designed to determine whether subject-matter in physical science would be learned as well under a group method of instruction as under a lecture-demonstration method in a general education course, disclosed that whereas the group method was found to be the more efficient with the abler students, the lecture-demonstration method was the more profitable with the least capable students.

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[1] J. E. Wallace Wallin, *Spelling Efficiency in Relation to Age, Grade and Sex, and the Question of Transfer* (Baltimore: Warwick and York, 1911).
W. H. Winch, 'Additional Researches on Learning to Spell, the Question of Transfer, and of Direct versus Indirect Methods', *Journal of Educational Psychology*, vol. vii, pp. 93-110, February 1916.

[2] John N. Ward, 'Group-Study versus Lecture-Demonstration Method in Physical Science Instruction for General Education College Students', *Journal of Experimental Education*, vol. xxiv, March 1956, no. 3, pp. 197-210.

It has usually been assumed that inductive methods are more profitable than deductive methods in teaching. This issue has been repeatedly subjected to experimental investigation. The earliest study of the relative merits of the respective methods was that made by Winch.[1] The subject-matter selected was geometrical definition. The preliminary tests required from the pupils participating spontaneous definitions of square, triangle, oblong, diameter. The answers were assessed by allowing one mark for each correct point, and the class was divided into equivalent groups on the results of this preliminary test. The two groups were then taught, one deductively, the other inductively. The former had definitions written out for them with illustrative drawings underneath, and they were instructed to study and learn the definitions. The other group was taught inductively, being led to form the definitions for themselves under the guidance of the teacher. Both groups were finally subjected to three tests, one immediately the learning was concluded to test immediate reproduction, one a week later to test deferred reproduction, and a third test was applied to determine how far the teaching or learning by the respective methods affected the pupils' powers to attack new material of an analogous kind.

The results indicated that when the test was on precisely what the pupils had been taught, in three out of five schools the conclusion was unanimously in favour of the deductive method. In two classes the inductive method was as successful as the deductive. There was some indication that the children inductively taught lost rather less of what they had known than those deductively taught when they were tested some time afterwards, but on the whole the tests of deferred reproduction gave the same comparative results as those of immediate reproduction. When, however, the pupils were required to apply themselves to new material, the pupils who were taught inductively did better work in every case than those taught deductively.

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[1] W. H. Winch, *Inductive versus Deductive Methods of Teaching*: An Experimental Research (Baltimore: Warwick & York, 1913).

H. L. Fowler investigated the same problem in *Induction or Deduction? An Experimental Investigation in the Psychology of Teaching.*[1] His problem arose out of the controversy regarding the teaching of grammar. His aim was to investigate the method by which the child reached his knowledge of such relationships as those between an adjective and a noun, and a verb and an adverb. After reviewing Winch's experiments Fowler contended that the results were not conclusive. Instead of using grammatical material Fowler constructed artificial tests, in which the relationships were analogous to those in grammatical material. In addition to investigating the relative merits of inductive and deductive methods Fowler included a composite method, and then introduced a modification—the prevention of error, of each of the three methods.

The results were not invariably consistent. The modified procedures, however, proved to be effective throughout the experiments and generally maintained their superiority.

Regarding the main methods the deductive, where there was explanation of the relation to be taught and immediate reference to particular cases, proved to be superior to the inductive methods. Reverting to the original issue, viz. the teaching of grammar, the author arrived at the conclusion that grammar appears to be a very difficult subject for children of 10 years 4 months to 10 years 11 months, the higher relations involved not being readily noticed and the subject-matter itself proving of little interest.

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[1] Melbourne University Press, 1931.

Another study[1] had as its aim to compare through experimental evaluation the learning of students instructed in such a manner as to stress the inductive-deductive approach with the learning of students instructed through the use of the more commonly found deductive-descriptive approach in the laboratory as it contributes to the objectives of high school chemistry.

Comparisons were made with respect to the relative attainment of each of four specific objectives and the total achievement involving all of these four: knowledge of basic facts and principles of chemistry; application of the principles of chemistry to new situations; knowledge of, and ability to use, the scientific method with an accompanying scientific attitude; ability to perform in the laboratory with resourcefulness using sound techniques.

In the inductive-deductive teaching the mode of attack was pupil-planned under teacher guidance. Teaching progressed from the particular to the general. In the deductive-descriptive teaching the experiments were carried out after the general principles involved had been thoroughly discussed. The exercises were used to describe the principles or to illustrate their applications. As the inductive-deductive class did as well as or better than the deductive-descriptive class in the attainment of the general outcomes of a high school course of chemistry but was significantly superior with respect to the crucial problem of attaining knowledge of and ability in the use of the methods of science, the acceptance of the inductive-deductive method was justified.

On similar lines comparisons of other methods could be instituted and gradually there could be built up a scientific educational method.

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[1] Clarence H. Boeck, 'The Inductive-Deductive Compared to the Deductive-Descriptive Approach to Laboratory Instruction in High School Chemistry', *Journal of Experimental Education*, vol. xix, March 1951, no. 3, pp. 246-53.

CHAPTER X

THE LEARNING PROCESS

PERHAPS the commonest delusion of the teacher is that the child's learning process corresponds to the teacher's mode of exposition. Of the alphabetic method of teaching reading it was once said that 'no child ever learned to read by that method; he learned in spite of it'.[1] The criticism has a wider application, and many uneconomical procedures survive in teaching because of this misapprehension. Thus the teacher may insist on rote learning or drill unaware of the fact that the pupils are doing their best to inject into their learning some semblance of meaning. The monograph of Brownell and Carper on *Learning the Multiplication Combinations*[2] affords clear proof that children who are *taught* by 'repetition' or drill do not *learn* by repetition. And they conclude:[3]

> Neither children nor adults for long take kindly to brute memorization. When presented with disordered arrays of independent items, they adopt some means of 'putting sense' into them. That is what children do when under conditions of drill they are required to master the multiplication combinations; and the immature procedures which they hit upon now and then are the means they have to relate and hold together the accumulating body of items to be learned. It is futile by prescribing more and more drill to prevent the appearance of such procedures, just as it is futile to try to remove them later by more and more drill. Children employ these procedures because they need them.

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[1] J. Welton, *Principles and Methods of Teaching* (London: University Tutorial Press, 1909, p. 115).

[2] W. A. Brownell and D. V. Carper, *Learning the Multiplication Combinations* (Duke University Press, 1943, p. 149).

[3] P. 150.

The difficulty which experimental psychologists encountered in devising series of nonsense syllables free from all associations supports Brownell's contention.

When it is recognised that a topic is not taught till it is learnt and that the pupils' mode of learning may not accord with the method of the teacher, it is easy to understand the new emphasis laid on the learning process.

The conditions affecting learning — what in the early days of experimental education was known as Mental Hygiene,[1] might be classified into the physical, the physiological and the mental. Physical conditions comprise illumination, ventilation, noise, etc.; the physiological include general conditions like fatigue, sleep, diet and specific defects — visual, hearing, left-handedness, etc.; the mental include readiness, motivation, technique of learning, etc. The content to be acquired must also be intelligible to, and have significance for, the learner.

The lighting and heating of schools are the concern of the architect and school authorities, and the teacher's duty is to see that the apparatus is functioning. The minimum intensity for light on desks and blackboards is given as 20-50 foot-candles.[2] For winter conditions a temperature of 68° F. and 60 per cent relative humidity, and for classrooms generally a temperature between 72° and 68° with relative humidities between 40 and 60 per cent respectively are recommended.[3]

[1] *Mental Health in Modern Education*, ed. N. B. Henry. Fifty-Fourth Yearbook of the National Society for the Study of Education, pt. 2 (Chicago: The University of Chicago Press, 1955).

Education and Mental Health, ed. W. D. Wall. UNESCO (G. G. Harrap & Co., 1955).

For recent bibliography see *Review of Educational Research*, vol. xxvi, no. 5, December 1956, 'Mental and Physical Health'.

[2] *Lighting Schoolrooms*. U.S. Office of Education Pamphlet No. 104 (Washington, D.C.: Govt. Printing Office, 1948), pp. 1-17.

American Standard Practice for School Lighting. Illuminating Engineering Society and American Institute of Architects (New York: Illuminating Engineering Society, 1948).

[3] Philip E. Nelbach, 'Modern Performance Standards for School Heating and Ventilation', *American Journal of Public Health*, cxii, January 1946, pp. 37-9.

The degree of noise that can be tolerated if teaching and learning are to be effective can be determined by use of a sound level meter.[1]

It has been contended that the season in which a child is born influences his development and learning capacity,[2] but this contention, at least so far as intelligence is concerned, has been negatived by a survey of Scottish children.

Fatigue has also to be reckoned with in arranging the pupils' daily schedule. It is defined as the decline in responsiveness or the impairment of the activity of an organism resulting from bodily or mental exertion indicated by a reduction of output or by the demand for increased effort to maintain efficient performance; in highly complex activities it manifests itself in the disintegration or disorganisation of the performance. Bartlett [3] has defined it thus: 'Fatigue is a term used to cover all those determinable changes in the expression of an activity which can be traced to the continuing exercises of that activity under its normal operational conditions, and which can be shown to lead, either immediately or after delay, to deterioration in the expression of that activity, or, more simply, to results within the activity that are not wanted'. Various stages have been demarcated in the investigations on fatigue.[4] In the first stage interest was centred in the laboratory, then transferred to the schoolroom,[5] thereafter to the factory floor. The first world war impressed on all the importance, in the interest of maintaining output, of considering all the physical and psychological conditions of work. Between the wars fundamental research was resumed, and in the second world war progress was accelerated by the needs of the Services, especially of the Royal Air Force.

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[1] Cf. *Hearing Defects of School Children.* Publications of the Scottish Council for Research in Education, xxxviii (University of London Press, 1956), p. 23.

[2] A. B. Fitt, *Seasonal Influence on Growth, Function and Inheritance* (New Zealand Council for Educational Research, 1941).

H. E. Jones, 'Seasonal Variations in I.Q.', *Journal of Experimental Education*, vol. x, December 1941, no. 2, pp. 91-9.

[3] F. Bartlett, 'Psychological Criteria of Fatigue', The Ergonomics Research Society *Symposium on Fatigue*, edited by W. F. Floyd and A. T. Welford (London: H. K. Lewis & Co., 1953).

[4] Cf. R. C. Browne, 'Fatigue, Fact or Fiction', *Symposium on Fatigue*, p. 137.

[5] Cf. *Mental Fatigue*, by M. Offner. Translated from the German by G. M. Whipple (Baltimore: Wardick & York Inc., 1911).

Fatigue can be estimated either *directly* through the diminution in the work itself or *indirectly* against an external criterion, a test being administered at the outset and again at the conclusion of the activity under review. Direct measurement has the advantage that a more reliable comparison can be obtained when the test applied is of the same nature as the work done than when the work is of one type and the test of another; the disadvantages lie in the facts that a different test has to be devised for each type of work, difficulty is found in securing sufficient uniform material, and practice effect has to be counteracted. In indirect measurement the same instrument can be used in assessing fatigue in different forms of work,[1] but dubiety arises as to the relationship between the work and a test of a quite different order, also as to whether the change in one is proportionate to the change in the other.

Tests of fatigue may also be regarded as physical or mental. The dynamometer — an instrument for recording gripping pressure, was early commandeered for the measurement of fatigue; the test was a physiological one, but doubts arose as to whether the same muscles were involved on different occasions, also whether the gripping power was not affected by mental factors like incentives, volition,[2] etc. To eliminate extraneous muscles from intervening and interfering the ergograph was devised;

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[1] 'But it is a fiction that there is a single entity called fatigue and that the search has only to be long enough to find a single test for it.' *Symposium on Fatigue*, p. 141.

[2] For techniques for controlling voluntary influences, see *Symposium on Fatigue*, pp. 147-8.

by clamping the hand and arm and leaving only a finger free to raise a weight, it was expected that a muscle could be isolated and the fatigue induced in it assessed, but difficulty was experienced in preventing the muscles of the arm and trunk being recruited. The ergogram or tracing of the attempts to raise the weight affords an objective record of the reduction in muscular effort but does not guarantee that the drop in the work curve is proportionate to the decrease in output.

McDougall [1] devised a dotting apparatus for investigating fatigue. The subject is required to mark with a pencil or pen an irregular zigzag row of dots, lithographed in red upon a paper tape, carried past the field of view at a speed regulated by the clockwork arrangement which rotates the drum to which the tape is affixed. The exercise demands sustained attention, and the failure to mark the dots correctly as they pass before the subject indicates the degree of fatigue. Of a more unequivocal mental nature is the cancellation test which requires the subject to elide a certain letter wherever it occurs in a printed text. Kraepelin substituted addition. Digits were arranged in vertical columns and the subject added each digit to the one immediately succeeding it. A mark was made every five minutes after the last digit added. Material psychologically uniform can be prepared in any quantity for this type of continuous working. Fatigue is manifested in a reduction in the rate, or in a decrease in the accuracy, of performance.

Whereas fatigue has considerable significance in industry, in primary schools with improved hygienic construction, a more realistic curriculum and the introduction of modern techniques of teaching, it may, from the results of various investigations, be regarded as negligible. But teachers should adopt preventive tactics and attend to the physical conditions of learning, as fatigue may be induced by temperatures outside certain limits, by humidity, also by unsuitable equipment.[1] Fatigue in secondary schools is attributable rather to extra-curricular activities, to late hours and excessive home preparation. The fatiguability of the teacher and its effect on the efficiency of instruction should not be ignored.

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[1] W. McDougall, 'On a New Method for the Study of Concurrent Mental Operations and of Mental Fatigue', *Brit. Jr. of Psych.*, vol. i, 1904–5, pp. 435-45.

Of the various sensory defects those of vision are generally obvious either to the parent or to the teacher, and facilities are usually available for referring the pupil suspected of defective vision to an ophthalmologist for treatment. An exception is colour blindness or colour defect, which has more numerous and far-reaching implications for vocational guidance than for school work.[2] It should nevertheless be borne in mind that a school course and the choice of a career are frequently interdependent,[3] and time should accordingly not be spent on a school course preparatory to a profession for which the pupil is congenitally handicapped. The incidence of colour defect is approximately 8 per cent for boys and 0·4 per cent for girls.

Hearing defects are more readily overlooked than visual; in fact, serious cases of auditory disability may throughout a pupil's school course escape detection and may even lead to a completely false assessment of his personality. In a Scottish county it was disclosed from an audiometric survey of an age-group of 4170 pupils that 325 had a defect of hearing, 108 of these having defects in both ears. This number was reduced through re-testing by 63. Only about 50 per cent of pupils with defects were known to teachers before the survey, and among pupils with the most serious defects a higher incidence of unfortunate behaviour traits was noted, although the teachers of some of these pupils were not aware of the defect of hearing.[1]

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[1] See *Human Factors in Equipment Design*, edited by W. F. Floyd and A. T. Welford. The Ergonomics Research Society Proceedings, vol. ii (London: H. K. Lewis & Co. Ltd., 1954).

[2] P. Cavanagh, 'The Ishihara Test and Defects of Colour Vision', *Occupational Psychology*, vol. 29, no. 1, January 1955, pp. 42-57.

[3] Cf. F. M. Earle, *Psychology and the Choice of a Career* (London: Methuen & Co. Ltd., 1933, p. 76) — 'Choosing a career and choosing a course of studies are almost identical problems'.

It is sometimes claimed that the more sensory modes that are appealed to, the more effective is the learning, but experiments in memorising and in spelling do not confirm this contention; an obvious instance to the contrary is the learning of touch typing where the introduction of visual control militates against success.

Before considering how children can best learn the various school subjects the teacher is faced with the problem as to when instruction in these subjects can most profitably be begun, that is, with the problem of 'readiness' for the various subjects and for the different aspects of these, for example, with the problem of reading readiness or readiness for beginning subtraction or learning the multiplication combinations in arithmetic.

The problem is sometimes dismissed with a vague reference to 'maturation', as if maturation itself were unaffected by environmental influences,[2] or a single factor like 'mental age' is isolated and readiness is based on this.[3] It is becoming increasingly evident, however, that many factors contribute to readiness and mastery of the earlier and more fundamental processes, say, in arithmetic, may be as helpful an index of readiness as mental age.[1] The complexity of the concept of readiness has been summarised thus: [2]

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[1] *Hearing Defects of School Children.*

[2] 'Reading readiness can be affected by training and is not dependent solely on maturation.' C. D. Taylor, 'Effect of Training on Reading Readiness', *Studies in Reading*, vol. ii. Publications of the Scottish Council for Research in Education, xxxiv (University of London Press, 1950).

[3] Mental age might have been suspect from the outset, as it represents general intelligence, the 'g' factor to use Spearman's symbol, whereas reading and arithmetic are special abilities, Sr, Sa. The accomplishment ratio illustrates the same defect; it seeks to equate g to Sr + Sa. Pupils with the same mental age may also have different I.Q.s and accordingly learn at different rates.

> Properly conceived, 'readiness' to learn anything involves the joint action of a number of factors. It obviously involves the intellectual ability to learn whatever is to be learned; but it involves much more than this. It involves the factor of motivation, the personal desire and intent to learn on the part of the learner. It involves, or may involve, social factors, for the child's cultural milieu may present him with the need, even the necessity, of learning. It may involve obscure physiological factors, such as those represented in the requisite degree of development of the parts (receptors and effectors) essential to learning.

It has also to be remarked that although the child may at a certain stage have the ability to acquire a topic, that is no justification for teaching it then, for the child may have no need of the knowledge at that particular time or the teaching of some other subject may have priority; on the other hand, premature presentation of a topic may be harmful as it may result in creating an inferiority complex in regard not only to the topic or subject but even to the whole of the school work.

It has been contended [3] that in the long run the best way to find out whether children are ready to learn anything in arithmetic or elsewhere is to teach that thing and to observe the results. It might nevertheless be suggested that another way of diagnosing readiness is to note whether the child has succeeded in learning part of a subject; thus, a child on entering school may be able to recognise words and numbers or may even be able to add simple fractions and subtract easy quantities. Ability to succeed in learning depends also on the standard of accomplishment set up, and children may be capable of learning the elements or the simpler items of a process at one stage without being in a position to master the whole, for example, in learning the multiplication products not exceeding 25 without being able to complete the whole set of combinations,[1] or in learning them when presented in one fashion and not in another. 'Readiness for what?' must accordingly be decided at the outset before a verdict can be given as to the child's capacity to begin a subject. The standard of attainment expected as well as the mode of presentation are thus both important factors in readiness.

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[1] Cf. W. Curr, 'Placement of Topics in Arithmetic', *Studies in Arithmetic*, vol. ii, pp. 183-218. Publications of the Scottish Council for Research in Education, xvii (University of London Press, 1941).

[2] W. A. Brownell and D. V. Carper, *Learning the Multiplication Combinations*, p. 105.

[3] Brownell and Carper, p. 136.

To Washburne is due the credit of first realising the significance of readiness, or, more generally, the grade-placement of topics, and of devising a technique for the solution of the problem.[2] His results were nevertheless so at variance with accepted practice which had hitherto not been without a certain measure of success, that suspicion was cast on the validity of his procedure. In general, the effect of Washburne's work and of his Committee of Seven was to step up the various aspects of the curriculum; reading, for example, was to be deferred till the mental age of 6 years and 6 months, but the disparity between the accepted practices and Washburne's recommendations was most marked in regard to arithmetic; in fact, according to Washburne's criteria pupils would not be ready for most of the arithmetical processes till after they have left school! Thus the minimum mental age for the learning of the easy multiplication facts was put at 8 years 9 months, and the placement of the hard facts three years later, at 11 years 9 months. Brownell has adduced evidence from other learning studies [3] which supports the view that children can learn the easy facts earlier than the stage assigned to them by Washburne and that all the multiplication combinations can be learnt at the time when Washburne believed children only capable of learning the easy series.

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[1] Brownell and Carper, p. 120.

[2] C. W. Washburne, *Adjusting the School to the Child* (New York: World Book Co., 1932).

[3] Pp. 136-9.

Brownell has indicated[1] that the stepping up of the processes in the curriculum coincided with the general trend in American educational theory of the time, epitomised in the phrase — the child-centred school. It has likewise not gone unremarked that the mental age of 6 years 6 months required for readiness coincides with the normal age of entry to American schools, whereas in Britain with an entering age of 5 reading can be attacked much earlier.[2]

These criticisms do not, however, detract from the significance of the concept of readiness in learning but should enable later investigators to plan their procedures more warily.

Without an incentive or some form of motivation, learning does not take place; that the learning is to be tested may in itself suffice to provide a motive. This need of an incentive was recognised by John Locke in *Some Thoughts Concerning Education* (1693):[3] 'Esteem and disgrace', he says, 'are, of all others, the most powerful incentives to the mind when once it is brought to relish them. If you can once get into children a love of credit and an apprehension of shame and disgrace, you have put into them the true principle which will constantly work and incline them to the right.'

Incentives cover a wide field and can be classified into 'Intrinsic' and 'Extrinsic'. The intrinsic may be objective, for example, when the significance of the content of learning has in itself sufficient appeal to induce the pupil to learn it, or it may be subjective, when, for example, the learning process itself is pleasurable and affords satisfaction to the learner. Extrinsic incentives include rewards and punishments; one extrinsic motive is competition, which may either be individual or group; individual competition may either be directed against others or against one's own previous achievement. Much controversy has been occasioned in education circles regarding the admission of competition; the objection is usually on moral grounds, and the issue has a long history, going back to Quintilian.[1]

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[1] Pp. 106-7.

[2] Cf. C. D. Taylor, 'Effect of Training on Reading Readiness'.

[3] Cambridge University Press, 1895, § 56.

To illustrate the type of investigation that has been undertaken we may cite Hurlock's reports.[2] In her first study on the value of praise and reproof as incentives for children she concluded that after one application the two on the whole were of equal value. In a further study, however, she found with four groups — Praised, Reproved, Ignored, Control — that at the end of a series of tests regardless of the factors of age, sex, initial ability or accuracy, praise is decidedly the most effective of the three incentives. Reproof, when first used, seemed to be about equal in value to praise, but with continued use its effectiveness showed a decided decline. To ignore children in a group where the other members are receiving some incentive, seems to be psychologically bad. The longer they are ignored, the less improvement do they show, even in spite of the opportunity to improve which comes from continued practice in one form of work. Hence praise is the best form of incentive to use, no matter from what angle we may regard the matter.

A type of incentive to which special attention has been given is knowledge of results. Its value is implicit in the proverb that nothing succeeds like success. To be conscious that one is progressing is heartening; to travel hopefully, as R. L. Stevenson puts it, is a better thing than to arrive.

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[1] See the author's *The Doctrines of the Great Educators*, revised and enlarged edition (London: Macmillan & Co. Ltd., 1954, p. 80).

[2] Elizabeth B. Hurlock, 'The Value of Praise and Reproof as Incentives for Children', *Archives de Psychologie*, 1924, no. 71, p. 78. Also 'An Evaluation of certain Incentives used in school work', *Journal of Educational Psychology*, 1925, vol. 16, pp. 145-9.

'Knowledge of results is the *sine qua non* of any kind of learning', quote Annett and Kay;[1] 'without reward', it has also been said,[2] 'people fail to learn'. This was illustrated in a study using an apparatus in which the subjects attempted by a movement of two hands to direct a spot of light on to the bull's-eye of a target, where it was found that no improvement in accuracy of performance occurs without knowledge of results; that improvement occurs with knowledge of results; that removal of knowledge of results after skill has been acquired leads to a deterioration of performance.[3]

Forlano[4] concluded from one of his experiments that learning accomplished under a promise of reward was more effective than when there was no reward and was as efficient as when a monetary reward was actually given; also that a delayed knowledge of results was slightly more efficient than with immediate knowledge of results. On the other hand, McGeoch and Irion affirm:[5] 'The conclusion derived from the general principles of learning, is that, for the most efficient learning, knowledge of results should be administered as quickly and as specifically as possible'. And add: 'It is probably this factor, more than any other, which makes individual instruction more effective than group instruction'.

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[1] John Annett and Harry Kay, 'Knowledge of Results and Skilled Performance', *Occupational Psychology*, April 1957, vol. 31, no. 2, p. 69.

[2] N. E. Miller and John Dollard, *Social Learning and Imitation* (Yale University Press, 1941, p. 32).

[3] J. L. Ewell and G. C. Grindley, 'The Effect of Knowledge of Results on Learning and Performance', *Brit. Jr. of Psych.*, vol. xxix, pt. i, July 1938, pp. 39-53. For review of literature see introduction to this article.

[4] G. Forlano, *School Learning with Various Methods of Practice and Rewards*, Teachers College Contributions to Education, no. 688, 1936, p. 96.

[5] J. A. McGeoch and A. L. Irion, *The Psychology of Human Learning* (New York: Longmans, Green & Co., 1952, p. 268).

To be told that one is wrong — a form of punishment or reproof — is disheartening, and, according to early experiments, had the effect of making the subject more likely to persist in his wrong course than if he were told nothing.[1] A later investigation modified this somewhat disconcerting conclusion, punishment having no uniform stamping-in influence but varying with the conditions. 'The influence of punishment varies with the medium by which it is conveyed and with the time elapsing between the application of the punishment and the next opportunity to repeat it.'[2] The mere fact that something happens after a response tends to strengthen the underlying connection; a reward may add to the strengthening influence and a punishment detract from it. 'When a signal carrying no information of success is given it has a decidedly stamping-in effect. When practically the same signal is made to inform the subject that he is right, the strengthening value is enhanced. When the signal informs the subject he is wrong, the strengthening influence is diminished.'[3] The general conclusion from animal experiments appears to be that punishment does not eliminate the response but merely inhibits it temporarily, and the corollary for education is that while 'the result of punishment as a means of social control has good backing from experimental psychology, punishment destroys the possibility of learning'.[4]

In 1828 David Stow, a Glasgow merchant, initiated a scheme for the training of teachers and opened a school to demonstrate his teaching methods. One of the principles with which his name is associated is 'the sympathy of numbers'. He maintained that children learn best in the company of others. Results obtained by Mayer and Schmidt at Würzburg [1] demonstrated generally a great superiority of school work over home work and of collective work over individual work. In a class and as a member of a community the child accomplishes more and better work than at home and working in isolation. Meumann nevertheless observes that certain children do better work in the restful environment of home as they are not in a position to overcome the inhibitions caused by class work.

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[1] E. L. Thorndike and R. T. Rock, 'Learning without Awareness of What is Being Learned or Intent to Learn It', *Journal of Experimental Psychology*, vol. xvii, no. 1, February 1934, pp. 1-19.

[2] P. 538.

[3] P. 555.

[4] Cf. P. M. Symonds, 'What Education Has to Learn from Psychology — Punishment', *Teachers College Record*, vol. 57, no. 7, April 1956, pp. 449-462. Also K. Lewin, *A Dynamic Theory of Personality*, chap. iv, pp. 114-70, 'The Psychological Situations of Reward and Punishment' (New York and London: McGraw-Hill Co. Inc., 1935).

The child cannot be expected by his own unaided efforts to hit upon the most economical and efficient procedures in learning. He should accordingly have put at his disposal the best techniques available. In schools which pride themselves on the freedom they concede to their scholars some guidance, even if only by way of suggestion, is advisable. As Meumann writes in regard to memorising,[2] and the same is true of all departments of the child's mental work, 'memorisation should not be a matter of accidental success as it has been in the past; nor should it be given over to the blundering efforts and the systematic grouping of the child. It should not entail the waste of time and of energy which necessarily results from a desultory and fortuitous procedure. The teacher must raise it to a higher plane; and this he can do by directing his pupils in their process of learning and by adapting their activity to conform with the results obtained from investigations of the conditions of economic learning.'

If the teacher turns to works on psychology for theories of learning, he finds himself overwhelmed by their number and variety and soon involved in the controversies regarding their validity. Only when the theoretical psychologists have composed their differences, is psychology likely to afford practical guidance to the educationist.[1]

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[1] Cf. E. Meumann, *The Psychology of Learning*. English translation (New York: D. Appleton & Co., 1913), pp. 345-6.

[2] E. Meumann, *The Psychology of Learning*, p. 336.

The two outstanding points of view are the Stimulus-Response Associationist or Connectionist view represented originally by E. L. Thorndike and the Gestalt or Field theory advocated by Koffka, Köhler, Bühler, Wertheimer and others of the German school.

Before considering these conflicting theories of learning we must dispose of a claim made by certain systems of education that they afford a sensory training. Certain philosophers analyse experience into its ultimate constituents which they designate 'sensations', but these ultimates are products of a logical analysis and are never encountered in actual experience. Psychologically, as a great psychologist — James Ward — has affirmed, 'the pure sensation we may regard as a psychological myth'; we cannot isolate a sensory capacity and train it; by training a sensory organ, *e.g.* the eye, we may only impair its efficiency. The most elementary situation the psychologist can manipulate is the perceptual.

It is accordingly at the perceptual or observational level that the various schools of learning part company. The Stimulus-Response Bond, Associationist or Connectionist theory is associated with the name of E. L. Thorndike, who derived from it a series of laws of learning.

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[1] E. R. Hilgard, *Theories of Learning* (New York: Appleton-Century-Croftis, Inc., 2nd edition, 1956).

G. Humphrey, *The Nature of Learning* (London: Kegan Paul, Trench, Trubner & Co., Ltd., 1933).

The Forty-First Yearbook of the National Society for the Study of Education. Part II: The Psychology of Learning (Bloomington, Illinois: Public School Publishing Co., 1942).

For short and simple account of learning theories see Studies in Education, The University of London Institute of Education, no. 7, *The Bearing of Recent Advances in Psychology on Educational Problems*; 'How Children Learn — Contemporary Psychological Theories of Learning', by R. W. Russell (London: Evans Brothers Ltd., 1955).

The most significant of these was his 'law of effect'. The after-effect of a successful attempt to solve a problematic situation must in some manner outweigh the effect of the more numerous unsuccessful efforts, otherwise no progress in trial-and-error learning would be possible. As experimental psychologists were, at the time of Thorndike's formulation of his laws, mainly preoccupied with reaction experiments involving the simplest sensory processes, there was a tendency to restrict the S.-R. theory to its most elementary form, thereby inviting criticism of its inadequacy. For Thorndike nevertheless both the stimulus and the response might be highly complex; the environmental situation originating the response could be general and the whole organism might be involved in the response. This enabled a great variety of experiences to be subsumed under the laws.[1]

A development of the stimulus-response doctrine is that known as conditioning, by which is understood grafting on to the original stimulus another stimulus which occasions the same response. Thus, as in Pavlov's experiments, when food is presented to a dog, the dog's mouth salivates. Food is the 'unconditioned' stimulus. On further presentation of food, a bell is sounded. Lastly the bell alone is sounded — the 'conditioned' stimulus — and the flow of saliva is induced. This is the 'conditioned reflex'.[2] If the bell alone should fail to effect the flow, food can again be associated with the sound of the bell and conditioning resumed; this is known as reinforcement. Unconditioning may be effected by eliminating the adventitious factor and restoring the original situation. An educational corollary would be associating a reward with a learning process itself not inherently attractive, then inducing the process without resort to the reward.

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[1] For defence of Thorndike on these lines see A. I. Gates, 'Connectionism: Present Concepts and Interpretations', *Forty-First Year Book of the Psychology of Learning*, chap. iv.

[2] 'Conditioning', as popularly used, does not necessarily imply the substitution of one stimulus by another; it is merely an alternative term for adaptation or adjustment to a situation.

From many interesting experiments the Gestalt psychologists infer that any component in the mental life derives its significance from its setting, that it cannot by itself have any independent value. The equivalent in formal logic is that the connotation of a term is conditioned by 'the universe of discourse' in which it is embodied or, generally, that the meaning of a word depends on the context. The educational corollary here is that knowledge forms a system, and that it is the relationship of one aspect to another that is important.

Extensions and qualifications of the theories and of the laws of learning have been introduced in attempts to explain the great variety in modes of human behaviour which exhibit learning, and even then they hardly quite succeed. Each theory emphasises a different aspect. The experiments on which the theories and laws are based have for the most part been performed on animals — rats, pigeons, hens, monkeys — and the inferences drawn from the results on lower forms of life to the higher human form must obviously be suspect. Resort is also frequently had to very speculative neurology. The whole matter is summed up by Hilgard in his *Theories of Learning* [1] in the statement: 'There are no laws of learning which can be taught with confidence. Even the most obvious facts of improvement with practice and the regulation of learning under reward and punishment are matters of theoretical dispute.'

As no one theory of learning seems capable of explaining all the facts, the teacher must accordingly turn to the results of empirical investigations.

The problems with which the technique of learning has been most concerned originate in connection with memorising. The issues to which more attention has been devoted are: whole or part learning; the distribution of repetitions. The conflict between whole or part learning is not modern although the techniques for resolving it are. Thus Quintilian[1] in his *Institutes* reflects:

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[1] Pp. 457-8.

> The committing to memory of a long speech will be least effected by parts, as thus memory will be less sensible of its burden. But these parts should not be scraps or sentences, for so their multitude, by dividing, would harass memory too much. I cannot well prescribe this extent, but it may be as each passage shall end, unless perhaps this passage is so long as to require likewise to be divided. Certain rests, however, should take place, that frequent meditation may continue the series of the words (the hardest thing to be mastered in this matter), and that afterwards the repeated order join the parts together.

Early experiments favoured the whole method, but reservations came to be made to the general principle in favour of a mixed method, more especially for longer passages. Conditions were found to be more varied and more complex than at first suspected. The conclusion that has been arrived at from reviewing the merits of learning passages by wholes compared with learning them by parts is that 'the method which is the more efficient varies with each variation of the situation. The age, training, memory span, I.Q. level of subjects, the form of the material learned, the method of learning it, etc., these facts suggest the advisability of adopting a relativist point of view in psychology — that all results are relative to the methods and conditions used in attaining the results.'[2]

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[1] Born A.D. 35 — died before A.D. 100.

[2] H. A. Carr, 'The Quest for Constants', *Psychological Review*, vol. 40, 1933, pp. 514-32.

Cf. Percival M. Symonds, 'What Education has to Learn from Psychology, iv — Whole versus Part Learning', *Teachers College Record*, March 1957, vol. 58, no. 6, pp. 329-39.

Forlano, from an elaborate investigation employing all the experimental techniques available at the time, concluded that the superiority of recitation or recall in the process of learning over reading and re-reading is clear and definite, even when classes of elementary school pupils in the fifth and sixth grade are employed as experimental units to learn the usual school material in the normal classroom milieu.[1]

Greater uniformity is forthcoming regarding the distribution of repetitions, although considerable diversity of opinion exists as to the explanation to be advanced to account for the greater efficiency of distributed than of concentrated repetitions.[2]

Ebbinghaus [3] found that for the re-learning of a series of nonsense syllables 38 repetitions distributed over the three preceding days had just as favourable an effect as 68 repetitions made on the day just previous. Experiments varying the number of repetitions and the intervals between the repetitions have confirmed the superiority of distributed over the cumulative arrangement of repetitions.

Several explanations have been offered to account for the phenomenon. In distributed learning we are dealing in the later repetitions with older associations whereas when all the repetitions come together, recent associations only are employed and the effect of consolidation is lost. Another contributing factor may be that in distributed learning there is a larger number of first repetitions or impressions, whereas as the series proceeds the efficacy of each repetition decreases. In trial-and-error learning, it has been said,[1] we need intervals not only to rest but also to forget the wrong responses, and with higher levels of learning these intervals may be lengthened without forgetting the right responses.

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[1] G. Forlano, *School Learning with Various Methods of Practice and Rewards*, Teachers College Contributions to Education, no. 688, 1936.

[2] For explanation of greater efficacy of massed over distributed practice, see *The Psychology of Human Learning*, by J. A. McGeoch and A. L. Irion, chap. v, pp. 138-93, 'The Distribution of Practice and Reminiscence'.

[3] H. Ebbinghaus, *Memory*. Translated by H. A. Ruger and C. E. Bussenius (New York: Teachers College, Columbia University, 1913). (Originally published at Leipzig in 1885.)

While repetition of the same material facilitates retention, subsequent learning of similar, but not identical, material adversely affects the retention of the original learning. This is known as retroactive inhibition,[2] and is an aspect of the interference theory of forgetting. The adverse effect of retroactive inhibition on previously learnt material has been found [3] to vary with the nature of the interpolated content and with the age of the pupil; thus arithmetic and memorising poetry had little or no effect on previously learnt lists of words, but with the younger pupils spelling produced marked interference, whereas it had no adverse effect with the older pupils. Generally, the closer the similarity of the two activities, the greater the effect of retroactive inhibition. Pleasurable learning material is less susceptible to retroaction than either unpleasant or indifferent material.

Attention has nevertheless been directed to the fact that practically all the experimental work on retroactive inhibition has been undertaken on artificial material, *e.g.* nonsense syllables, and that the results may be significantly altered when the type of learning occurring in the classroom is considered.[4] Instead of the new prejudicing the retention of the old, the existing knowledge in the mind may adversely affect the new. This is proactive inhibition. The new learning may become embodied in the already existing knowledge, thereby losing its identity and the possibility of its recall as an independent entity. The conclusions reached with school subjects as the material of experiment support the contention[1] that where such school material is involved proactive rather than retroactive inhibition is the determining factor in forgetting; also that interpolated learning of material substantially similar to, but not identical with, the original learning task does not result in retroactive inhibition but induces as much retroactive facilitation as identical repetition of the learning material. Such results indicate the value of experiments with schoolroom rather than with laboratory material.

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[1] H. Easley, 'The Curve of Forgetting and the Distribution of Practice', *The Journal of Educational Psychology*, vol. xxviii, September 1937, No. 6, pp. 474-8.

[2] Ester J. Swenson, *Retroactive Inhibition*: A Review of the Literature (Minneapolis: The University of Minnesota Studies in Education, Number One, 1941).

[3] T. G. Foran, 'Retroactive Inhibition in Relation to Age and the Nature of the Interpolated Task', *The Journal of Educational Psychology*, vol. xxviii, September 1937, No. 6, pp. 451-60.

[4] D. A. Ausubel, L. C. Robbins and E. Blake, 'Retroactive Inhibition and Facilitation in the Learning of School Materials', *The Journal of Educational Psychology*, vol. xlviii, October 1951, no. 6, pp. 334-43.

The study of the acquisition of skill originated in America and the early experiments included typewriting, tossing and catching balls, and solving mechanical puzzles.[2] Instead of progress in learning appearing uniform, as might be expected, it is found that rapid advances alternate with periods of arrest, even of retrogression. These periods of marking time are of the utmost significance, and from the shape of the curve of learning have come to be known as 'plateaus'.

The early stages in the acquisition of skill are characterised by marked and continuous improvement. The lack of adaptation and of attunement to novel conditions should be expected to militate against rapid progress but such initial handicaps are compensated for, or are more than counter-balanced by the enthusiasm with which a new undertaking is entered on. The stimulus of interest is nevertheless only temporary; the novelty wears off, difficulties obtrude, and the depression of the plateau sets in. Various explanations have been hazarded to account for the presence of plateaus. They are believed to originate when a single method which is not the most efficient becomes established, or when rival methods are competing for mastery. They may occur when lower-order habits have not become sufficiently automatic to free attention for higher-order habits; on the other hand, it is contended that we need not wait till lower-order habits are completely established before attempts at higher-order habits are initiated. The pedagogical corollary of the former view is that new ground should not be broken till the old is completely mastered; the latter interpretation of the plateau provides a warning against remaining at work on a low plane when possibilities of improvement are presented.

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[1] *The Journal of Educational Psychology*, vol. xlviii, p. 343.

[2] W. L. Bryant and N. Haster, *Psychological Review*, vol. iv, vol. vi.
J. Swift, *Mind in the Making*, chap. vi.
W. F. Book, *The Psychology of Skill*. (University of Montana Publications in Psychology, no. 1, 1908.)
H. A. Ruger, *The Psychology of Efficiency*. (Columbia Contributions to Philosophy and Psychology, vol. xix, no. 2, 1910.)

The pupil's dilemma when, in spite of all his efforts, he finds he is making no progress is the teacher's opportunity. As the tyranny of a complex is broken when the psycho-analyst brings to light, and makes the patient conscious of, the inhibiting force, so will the plateau lose its crippling effect on the pupil when its cause is explained to him. Thus if the state of stagnation represented by the plateau results from the failure of profitable variations to appear, the teacher can offer suggestions; if the plateau has resulted from the adoption of a chance variation which is not the most efficient, the teacher must strive to prevent the inefficient procedure from becoming automatised, must help the pupil to analyse the activities involved and reconstruct them on a more satisfactory pattern. No matter what the cause, he must prevent the pupil from being depressed and thereby prolonging the plateau period; this he may do by directing the pupil's attention to the presence of any higher-order habits which may be present. Above all he must use every means at his disposal to reinforce the pupil's morale.

The general conditions favourable to progress in the acquisition of skill comprise the physical condition of the learner and confidence in his own ability. In ball-tossing experiments it was the delicate movements of the hand that were affected by low physical condition, and in typewriting it was the newly formed group-associations that suffered most from this cause. Favourable variations also appeared on 'good days'. It was noted too that a growing feeling of confidence preceded a permanent rise. It is when all the conditions are favourable that the forward steps or new adaptations in learning are made.

In spite of all the precautions taken by the teacher and the adoption of the most approved techniques by the learner it may happen that failure ensues. Even in the 'child-centred' school this is recognised, and Dewey comments:[1] 'But limitation of capacity is one of the things which has to be learned; like other things, it is learned through the experience of consequences'. Failure has even been said to be educative; thus — 'The establishment through success of the child's confidence in his power to learn, the elimination of the total failures which are so painful and destructive of morale, and the adjustment of educational demands to the pupil's capacity to learn are important, indeed fundamental, contributions to mental health. This does not mean that children should never be allowed to fail, nor that they should never be challenged by tasks which are outside their immediate possibilities. Failure is educative and even the most able among us has to learn not to be destroyed by it. The balance of a child's experience, especially in the early years, should be on the side of success; the watchful teacher will see to it that the failures incidental to learning are not total, that they act as a spur to further effort which is ultimately successful. This again demands careful grading in terms not only of each pupil's intellectual capacity but of his ability emotionally to tolerate failure.'[1]

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[1] J. Dewey, *Democracy and Education* (New York: The Macmillan Co., 1946), p. 231.

Unless learning has a certain degree of permanence and can be recalled when required, it is of little avail. Every impression made on the mind may nevertheless be said to be permanently retained but much cannot be readily recalled, and some experiences, although they may be influencing our present conduct, can only be disinterred by the techniques of the psycho-analyst. Permanence of learning generally depends, it is claimed,[2] on *how* the material is acquired. The American view is that learning involving problem-solving relationships and the operation of the higher mental processes is relatively permanent whereas unrelated facts and mere information are relatively temporary. The more highly integrated into the mental system the new knowledge is, the longer is it likely to be retained. Other factors than the mode of learning may nevertheless affect the retention of learning. Thus in an investigation where the subject-matter was chemistry,[3] the conclusions reached were: 'The amount of chemistry retained was more closely related to achievement than to intelligence. Pupils who planned to attend college retained more chemistry than pupils who did not plan to attend college. Pupils who expressed a preference for chemistry among the subjects retained more than pupils who expressed preference for other subjects. Pupils enrolled in physics retained more chemistry than pupils not enrolled in physics. The sex of the pupils was not a factor in retention. There was no significant difference in the type of learning retained.'

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[1] *Education and Mental Health*, edited by W. D. Wall, UNESCO (London: Geo. G. Harrap & Co.), p. 94.

[2] Edited by E. F. Lindquist, *Educational Measurement*, p. 23. See also references there given.

[3] J. R. Smeltz, 'A Study of the Retention of Learnings in High School Chemistry for a period of one year', *Penn State Review of Educational Research*, vol. vii, no. 1, November 1955, pp. 3-4.

Whether the learning of one subject facilitates the learning of another subject might be said to be the perennial problem in education.[1] Plato raises the issue in the *Republic* where, however, his statements are inconsistent.[2] It reappears in the writings of almost all the great educators, and was first challenged by Herbart (1771–1841). Investigations bearing directly or indirectly on the topic are so numerous as to form a literature of its own, and as far back as 1916 a bibliography extended to 256 items.[3] Yet even to-day the issue excites controversy in the press and in educational journals, and unfounded assertions are repeated with all the dogmatism of those who mistake ignorance for originality. It is surprising, too, how long the contradictory view escaped notice, that the learning of one subject might prejudice the learning of a second, although every teacher is aware of the difficulty of teaching pupils who have already acquired the same process by other methods. It has been noted [4] that geographic terms like *belt*, *centre*, *deposits*, *coalfields*, *raw materials*, *possessions*, having non-geographic meanings before the study of geography is begun, may impede, rather than facilitate, learning and result in negative transfer.

The doctrine has been known under various titles —

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[1] Cf. W. B. Kolesnik, 'A Note on Transfer of Training Research', *Peabody Journal of Education*, January 1957, vol. 34, no. 4, pp. 215-19. 'Since the beginning of the twentieth century there have been published at least 500 articles dealing directly with the problem of Transfer of Training.' For selected bibliography, see pp. 217-19.

[2] See the writer's *The Doctrines of the Great Educators* (London: Macmillan & Co. Ltd., 1956).

[3] J. E. Coover, *Formal Discipline from the Standpoint of Experimental Psychology*. Psychological Monographs, vol. xx, no. 3, January 1916 (Princeton, N.J.: Psychological Review Co.).

[4] T. J. Eskridge, *Growth in Understanding of Geographic Terms in Grades IV to VII* (Duke University Press, 1939), p. 66.

disciplinary education, formal training, transfer of training — denoting stages in the development and refinement of the problem.

The opposing views might be expressed in the following antithesis: It must be acknowledged that we cannot directly prepare the pupil to meet all the manifold situations that he will subsequently encounter in life and the best we can do is to give him a disciplined mind which, we trust, he will be able to apply as occasion demands. To this the retort is made: It is admitted that we cannot solve all the problems of life in advance. What we can do nevertheless is to acquaint the pupil with as many of the things as possible that experience declares he is likely to meet with in life, for, as Comenius (1592–1670) proposed, 'we must take strong and vigorous measures that no man in his journey through life may encounter anything unknown to him that he cannot pass sound judgment upon it and turn it to its proper use without serious error'. The former school would provide an *intensive* education, emphasising the importance of the training or the discipline that is to be derived from a course of study; their opponents would provide an *extensive* education, insisting on the value of the content of instruction, on its utility and social significance.

That some transfer of the improvement resulting from training is possible and actually takes place in learning and in life cannot be disputed. Every application of a principle to new analogous material implies transfer. Without the possibility of transfer every situation in life would have to be tackled *ab novo*; we should be overwhelmed by their number and variety and fail to cope with them. Nevertheless this does not justify the extravagant claims made by the formal training school, and we may wonder at the temerity of the statesman who claimed that a classical education was the best training for an air pilot! What has to be determined are: In what cases does transfer take place or not take place? What amount of improvement resulting from training is transferable? And how is the transfer when it does take place to be explained?

When experimental methods came to be applied to the solution of educational problems it was natural that the doctrine of formal training should be subjected to experimental treatment. The problem came to be more precisely defined and to be characterised as transfer of training. The earliest applications of the experimental techniques, however, produced the most hopelessly conflicting results. Transfer was disclosed where it was least expected, and was absent where it might be assumed to occur.

The first attack on the issue experimentally was that by Thorndike and Woodworth.[1] The plan adopted was to test the efficiency of one function, then to give training in some other function until a certain amount of improvement was reached, and thereafter to re-test the first function. Areas of rectangles of various sizes and shapes afforded the training and the testing material. The results showed that the improvement in estimating the areas of rectangles of a certain shape is not equalled in the case of other shapes.[2] The inference drawn was that the functions of judging nearly equal magnitudes are, sometimes at least, largely separate and independent. A high degree of ability in one sometimes coexists with a low degree of ability in others.[3] Similar results were obtained when the shapes of rectangles remained constant and only the size of the training and testing rectangles varied.[4] The same holds when both size and shape alter, and the conclusion reached is 'that there is no inner necessity for improvement of one function to improve others closely similar to it, due to a subtle transfer of practice effect'.

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[1] E. L. Thorndike and R. S. Woodworth, 'The Influence of Improvement in the Mental Function upon the Efficiency of Other Functions', *Psychological Review*, vol. viii, 1901, pp. 247-61, 384-95, 553-64.

[2] P. 252.

[3] P. 261.

[4] P. 386.

Further experiments involved observing accurately some detailed features of words on printed pages, with the result [1] that the improvement in the function of observing and marking words containing, for example, *s* and *c* is not equivalent to improvement in the function of observing the make-up of words. Neither the speed nor the accuracy in the training is a general power equally applicable to other data. Concluding this series of experiments the authors remark that the next steps in the study of the independence of mental functions would seem to be the exact analysis of the influence of one on the other where such is present and the discovery of its amount and nature in case of practical importance, for instance, in the case of training in school subjects, occupations or games.

Twenty years later Thorndike addressed himself to this issue.[2] His method was to compare the gains for the pupils who studied English, history, geometry and Latin during the year with the gains for the pupils who studied English, history, geometry and shopwork, the difference in gain in English representing the difference between Latin and shopwork. The facts indicate [3] that the amount of general improvement due to studies is small; that the differences between studies in respect of it are small, so that the values of studies must be decided largely by consideration of the special training which they gave; and that the languages have no claim to pre-eminence. And by any reasonable interpretation of the results it appears [4] that the physical sciences are equal, if not superior, to languages and mathematics as then taught in American cities, in respect of mental discipline from any point of view. Thorndike's final conclusion is that the intellectual value of studies should be determined largely by the special information, habits, interests, attitudes and ideals which they demonstrably produce. The expectation of any large differences in general improvement of the mind from one study rather than another seems doomed to disappoint.

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[1] P. 558.

[2] 'Mental Discipline in High School Subjects', *The Journal of Educational Psychology*, vol. xv, January 1924, pp. 1-22; February 1924, 83-98.

[3] Pp. 96-7.

[4] P. 98.

Bagley[1] accepts Thorndike's results and concedes that habit training is specific — a generalised habit being 'a psychological absurdity'.[2] Nevertheless instances can be cited of people who, for example, are neat in all departments of life. The explanation Bagley offers is that those who carry over the habit from one department to another really carry over a generalised *ideal* of neatness. The ideal furnishes a motive which holds the person till the habit in the new department is established. The lesson for education, Bagley infers, is that unless the ideal of mastering a subject has been developed consciously there can be no certainty that the power to master other subjects will be increased, no matter how intrinsically well the subject may have been mastered.[3]

For his contention Bagley offered no experimental support. It was left to Ruediger[4] to supply this. His problem was: 'Does the ideal of neatness brought out in connection with, and applied in, one school subject function in other school subjects?' The procedure adopted was to pay all attention possible to the habit and the ideal of neatness in one school subject — the training subject — also to emphasise neatness in connection with the affairs of ordinary life, not to exclude all reference to neatness in the testing subject. The experiment was continued for eight weeks. From an examination of the resulting data it was evident that neatness made conscious as an ideal in connection with one school subject does function in other subjects. Ruediger's results justify, he claims,[1] the conclusion: 'To bring to consciousness the general relations of aims and method, and to refer them to the activities of life, adds not only to the interest but also directly to the results achieved. There is such a thing as the indirect improvement of mental function, even in spheres quite subtile, but the means of such improvement must receive direct attention. And this is the essential point. To expect something to come somehow and in some way is a vain hope. Our results in mental training follow only upon the expenditure of definite and intelligent effort, but with this, they seem to be everywhere commensurate.'

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[1] W. C. Bagley, *The Educative Process* (New York: The Macmillan Company, 1908), chap. xiii.

[2] P. 212.

[3] P. 216.

[4] W. C. Ruediger, 'The Indirect Improvement of Mental Function Thru Ideals', *Educational Review*, vol. xxxvi, 1908, pp. 364-71.

Judd[2] approached the problem from a different angle. After some experiments in estimating the length of lines in which both positive and negative transfer were exhibited, he arranged an experiment in which two groups of pupils in the fifth and sixth grades were required to hit with a small dart a target placed under water. One group was given a full theoretical explanation of refraction, the other was left to work without theoretical training. Those two groups began practice with the target under twelve inches of water. It is a very striking fact, Judd says, that in the first series of trials the boys who knew the theory of refraction and those who did not, gave about the same results. That is, theory seemed to be of no value in the first tests. All the boys had to learn to use the dart, and theory proved to be no substitute for practice. At this point the conditions were changed. The twelve inches of water were reduced to four. The difference between the two groups of boys now came out very strikingly. The boys without theory were very much confused. The practice gained with twelve inches of water did not help them with four inches. Their errors were large and persistent. On the other hand the boys who had the theory fitted themselves to four inches very rapidly. Their theory helped them to see the reason why they must not apply the twelve-inch habit to four inches of water. Theory, it should be noted, was not of value until it was backed by practice, but when practice and theory were both present the best adjustment was worked out. Theory, Judd infers,[1] is not a substitute for direct experience; it is rather a frame in which experience may be properly held apart and at the same time held together, and he concludes: 'Such an example as this makes it clear that every experience has in it the possibilities of generalisation'.

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[1] P. 371.

[2] C. H. Judd, 'The Relation of Special Training to General Intelligence', *Educational Review*, vol. xxxvi, 1908, pp. 28-42.

E. Ebert and E. Meumann found transfer that was 'unequivocal and positive'.[2] The special memories of their subjects were first tested; training on nonsense syllables followed; thereafter the special memories were re-tested. Improvement was found to have occurred. The inference drawn by Meumann was that related memories exist which can be perfected upon any material involving the use of memory.[3] This, he claimed, justified the formal training or disciplining of memory but only in so far as formal training of memory and a systematic improvement of the method of learning can be combined with the subject-matter already prescribed in the school curriculum. He rejected the introduction of training on artificial material, since what might justly be demanded for memory could with equal justice be demanded for other mental functions — apprehension, observation, judgment, etc.

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[1] *Educational Review*, vol. xxxvi, p. 38.

[2] *The Psychology of Learning*, p. 352.

[3] The contention that a common feature is present in different types of memory would now be adjudged by the statistical procedure termed 'factorial analysis', but a 'factor' is not to be identified with a 'faculty', the former being merely a statistical concept extracted from a series of correlations between the results of various tests, or simply a description, whereas the latter is regarded as a mental power.

Cf. C. Burt, 'The Structure of the Mind; a Review of the Results of Factor Analysis', *The British Journal of Educational Psychology*, 1949, vol. 19, pp. 100-11, 176-99. Also, P. E. Vernon, *The Structure of Mental Abilities*, Methuen's Manuals of Modern Psychology, no. 1, 1950, and P. E. H. Barratt, 'The Role of Factors in Ability Theory', *Australian Journal of Psychology*, vol. 8, December 1956, no. 2, pp. 93-105.

Investigations of W. H. Winch in London [1] confirmed the conclusions of Ebert and Meumann. Practice in rote memory was followed by improvement in substance memory for stories. But, like Meumann, Winch maintains that although pedagogically the fact of transfer is unquestionable, this should not lead us to adopt indirect or formal training methods unless the improvement thereby secured is greater than that obtained by a direct attack on the subject-matter really requiring to be learnt.

From these early experiments and succeeding ones too numerous to review [2] we may conclude that transfer occurs but that it does not come about automatically. To ensure transfer the teacher should direct attention to common elements where these are present, stimulate an interest in ideals, or generalise principles by indicating their applications. To get the most out of his teaching he should strive for transfer. The pupil on his part should adopt the same methods of study for different subjects, thus economising effort and effecting transfer. The more intelligent he is, the more likely is he to see connections for himself; the inventor, in fact, sees how a device can be utilised for a different purpose, and the genius how an arrangement fits in quite another sphere. Many factors combine to effect transfer. If knowledge is not to be a thing of shreds and patches, transfer must operate. 'The fundamental educational problem is to discover and establish the conditions which contribute most to the utilisation of experience.' [1]

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[1] 'The Transfer of Improvement in Memory in School-children', *Brit. Jr. of Psych.*, 1909-10, vol. iii, pp. 386-405. Cf. *The Journal of Educational Psychology*, 1910, vol. i, p. 588.

[2] For such a review see P. T. Orata, 'Recent Research Studies on Transfer of Training with Implications for the Curriculum, Guidance and Personnel Work', *Journal of Educational Research*, vol. xxxv, October 1941, no. 2, pp. 81-101. The bibliography appended to this article comprises 196 items.

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[1] T. E. Christensen, 'Work Experience and Transfer of Training', *School Review*, vol. liii, December 1945, no. 10, pp. 588-94.

CHAPTER XI

DISCIPLINE

To elucidate the factors which contribute to good classroom discipline an attempt has been made to justify the contention that 'the problem of discipline can be met best not by authoritarian control or robot bullying but through well-planned efficient teaching by a real human being, keenly aware of the sensitivities, ambitions, and foibles of those seated before him, able to sense the humor and pathos of their lives, and willing to make their learning and personality growth his fundamental aim in teaching'.[1] The criterion adopted was the independent assessment of the teachers' discipline by the principals of the schools in which the teachers, eighty-two in number, were engaged. A rating chart testing thirty-eight practices was prepared and used by the observer (the author), and, as a check on the objectivity of the rating, twenty additional teachers were observed concurrently, but without any collaboration, by the observer and one of four accredited supervisors.

The conclusions reached were:[2]

1. The practice of using all available equipment and visual aids to embellish and enrich a lesson so as to interest and promote the learning growth of pupils is closely associated with effective discipline.

2. The practice of routinising various classroom procedures such as the distribution of paper, copying of the assignment, entering or leaving the room, etc., in developing the mechanics of the classroom as well-formed habits is another practice closely associated with effective discipline.

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[1] S. L. Cellar, 'Practices Associated with Effective Discipline: A Descriptive Statistical Study of Discipline', *Journal of Experimental Education*, vol. xix, June 1951, no. 4, pp. 333-58.

[2] P. 357.

3. The practice of presenting the subject-matter in a vital and enthusiastic manner, of making the subject-matter appealing to the point that the interest and the enthusiasm catches on enough so that the subject-matter itself acts as a check or control to incipient misbehaviour is also closely associated with effective discipline.

4. A number of other practices describing skilful techniques of classroom teaching such as keeping the class moving without idleness, using simple devices and providing elastic endings, are moderately associated with effective discipline.

To obtain an insight into the behavioural structure of a class an original technique has been provided by Moreno.[1] The aim of his work is to organise groups of children in a school to the greatest advantage of the individual members and of groups as wholes.[2] To this end a sociometric test is applied. Instead of the necessary information regarding the social attitudes of children being obtained by observation only, by means of the sociometric test the pupils themselves supply the data. They are asked to record whom they like or dislike among their classmates, etc. It is necessary, Moreno warns us,[3] 'that the subjects themselves be taken into partnership, that they become sufficiently interested in the test, that they transfer to the tester their spontaneous attitudes, thoughts and motivations in respect to the individuals concerned in the same criterion'. If they are merely asked whom they like or dislike irrespective of any criterion and without an immediate purpose for them, the test does not provide a systematic basis for sociometric research.

Once the test has been applied, the results can be diagrammatised in the form of a sociogram, a sociogram being a chart indicating visually the underlying structure of a group and the position of each individual in it.[4] To devise a sociogram the names or initials of the members of a class can be arranged round the circumference of a circle, boys being represented by triangles, girls by circles. They are then linked up by signs indicating attraction, mutual repulsion, mutual indifference. The structure of the sociogram reveals which pupils are popular — the stars — those chosen by a considerable number of their fellow pupils; the isolates or rejects — those whom nobody chooses or those with whom others do not wish to be associated; also the existence of cliques among the pupils.

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[1] J. L. Moreno (1892–), *Who Shall Survive?* A New Approach to the Problem of Human Interrelations (Washington, D.C.: Nervous and Mental Disease Publishing Co., 1934).

[2] P. 335.

[3] P. 10.

[4] Pp. 8, 432.

A sociometric test given to pupils of all classes from the kindergarten to eighth grade in an American school, requiring them to choose among their classmates those whom each wants to have to stay in the same room and to sit near him, uncovered a complex structure of the class organisation widely differing from the prevalent one. A quantitative analysis revealed that the proportion of boys choosing girls and of girls choosing boys varied from grade to grade, that the number of individuals isolated fluctuated between 15 and 35 per cent in the various classes — that the teachers' judgments coincided in 48 per cent in respect to the most chosen boys and girls.[1] The test is claimed [2] to open a way to the recognition of delinquency in its initial stage and to provide a scientific method of diagnosing its predisposing causes and of developing preventive measures.[3]

Although they were conducted in clubs for 10-year-old boys certain experiments with different types of discipline [4] are suggestive for classroom practice. The aim of the experiments was the intensive study of the effects upon individual and group behaviour of variations in social atmosphere, designated authoritarian, democratic and *laissez-faire*. In the case of the authoritarian treatment the group leader dominated the situation, prescribed in detail the activities and remained aloof from participation; in the democratic treatment the activities in which the boys engaged were adopted by group discussions assisted by the leader, boys were free to choose the companion with whom to work, and the division of tasks was left to the boys; in the *laissez-faire* treatment complete freedom for group and individual decision was allowed with a minimum of leader participation. As the reaction to authoritarian adult leadership took two forms, (1) an aggressive, irritable, self-centred type, and (2) a submissive, highly dependent, socially apathetic type, four main atmospheres were distinguished: (*a*) the submissive reaction to autocracy; (*b*) the aggressive reaction to autocracy; (*c*) the democratic; (*d*) the *laissez-faire*. It was found that morale was decidedly higher in the democratic group than in the *laissez-faire* or in either type of reaction to autocracy. Expressions of discontent were lower with the democratic group and highest with the aggressive autocratic group. Loafing was least with the democratic and the submissive autocratic group, and greatest with the *laissez-faire* group. In the view of the argument for unrestricted freedom in the schools it is significant [1] that 'there is much evidence indicating that the boys in the *laissez-faire* situation became dissatisfied with their own lack of efficiency and of solid accomplishment. They wanted to accomplish things, and they wanted the satisfaction of accomplishing them cooperatively as a harmonious working group. Both needs — the workmanlike need and the social need — were frustrated in *laissez-faire*. This was shown, for instance, by the high frequency of proposals for united action . . . proposals which usually remained abortive because of incapacity to co-operate in carrying them out.' 'There was evidence that at least a majority of the boys had a need for "clearness of structure" in their psychological environment. There was a tendency to be dissatisfied by chaos, confusion, uncertainty.'

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[1] Pp. 24-5.

[2] P. 57.

[3] For experiments in sociometry see J. E. Richardson, J. F. Forrester, J. K. Shulka, P. J. Higginbotham, *Studies in the Social Psychology of Adolescence* (London: Routledge & Kegan Paul, Ltd., 1951), pp. 3-146.

[4] R. Lippitt and R. K. White, 'The "Social Climate" of Children's Groups', *Child Behaviour and Development*, chap. xxviii, pp. 485-508. Edited by R. G. Barker, J. S. Kounin and H. F. Wright (New York and London: McGraw-Hill Co., 1943). Also, *Studies in the Social Psychology of Adolescence*, pp. 11-12.

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[1] Lippitt and White, p. 503.

From an unpublished thesis [1] it would appear that no significant difference in teacher activities and human relations in terms of democratic as contrasted with authoritarian working patterns of school principals was found, whereas another thesis reported that pupils in democratic schools expressed more favourable attitudes towards the school than did pupils under authoritarian leadership.

To sense the psychological climate of the classroom a technique has been devised to quantify the contacts of pupil and of teacher with pupil.[2] These contacts are classified into (1) dominative or dictatorial, (2) integrative or democratic, the criterion of dominative behaviour being conformity by the child, that of integrative behaviour being joint participation by the child or by the group; commands, threats, shame, blame are dominative ways of acting, inviting co-operation is integrative or democratic. A tendency to meet aggression with aggression, and co-operation with co-operation was revealed, whereas it should be the teacher's aim to break the vicious circle in regard to dominative contacts. At the kindergarten stage it was found, in the study reported by Anderson and Brewer, that the teachers had higher mean frequencies of dominative than of integrative contacts, that among the contacts initiated by the teacher two out of three were dominative, that on the other hand, among teacher contacts which resulted from the child's initiative, six out of seven were integrative.[1] The measures in this study showed that teachers were different in the morning from what they were in the afternoon, there being a greater number of 'group' contacts, that is, remarks addressed to the class as a whole, and fewer individual contacts in the afternoon. It is hazarded that children enrolled in the morning session in kindergarten secure more and better teaching than children who attend in the afternoon.[2]

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[1] *Review of Educational Research*, vol. xxvi, no. 5, December 1956, p. 509.

[2] H. H. Anderson and H. M. Brewer, *Studies of Teachers' Classroom Personalities*, I. I, Dominative and Socially Integrative Behaviour of Kindergarten Teachers. Applied Psychology Monographs, no. 6, July 1945. (Stanford University Press.)

H. H. Anderson and J. E. Brewer, II, Effects of Teachers' Dominative and Integrative Contacts on Children's Classroom Behaviour. Applied Psychology Monographs, no. 8, June 1946.

H. H. Anderson, J. E. Brewer, M. F. Reed, III, Follow-up Studies of the Effects of Dominative and Integrative Contacts on Children's Behaviour. Applied Psychology Monographs, no. 11, December 1946.

More precise categories were adopted for the elementary school level. These comprised: [3]

Domination with evidence of conflict.
Domination with no evidence of conflict; this category subdivided into directive and lecture method.
Domination with evidence of working together.
Integration with no evidence of working together.
Integration with evidence of working together.

Two second-grade classes to which the children had been assigned by lot were studied. The teacher of one class was found to be more integrative in her contacts with children; the teacher of the other class was consistently more dominative. The children with the more integrative teacher showed significant lower frequencies of *looking up* at seat work, *playing with foreign objects* and both of *conforming* and *non-conforming* behaviour. They were also significantly higher in frequencies in several categories representing spontaneity and initiative and social contributions both voluntary and in response to others.[4]

[1] Anderson and Brewer, p. 156.

[2] P. 81.

[3] II, p. 118.

[4] II, p. 124.

Observations were also made in two fourth-grade and in one sixth-grade room. The two fourth-grade teachers showed certain conspicuous differences in their classroom behaviour. One used eight times as many group contacts assigned to the integrative, working-together category, as did the other; she worked twice as frequently with her children as against them. Her children showed higher frequencies in those categories representing spontaneity and initiative, problem-solving and social contributions, and lower frequencies in dominating other children and in nervous habits. The sixth-grade teacher when compared with the fourth-grade teachers had more favourable frequencies in all categories.[1]

A further investigation was planned [2] to learn whether with different classes the same characteristics persisted with the second-grade teachers when they were in charge of other classes, and whether their influence on the pupils could still be detected when these pupils were advanced to a higher class. It was found that with other classes, although the teachers were in a less contrasting position for group and individual contacts of both dominating and integrating types, the previous differences were maintained, and it was concluded that in spite of the variations the measures revealed some sort of basic differences in the personalities of the two teachers.[3] The results of pupils who passed from the second grade to the third grade offered no support for an assumption that in certain children there were persistent behaviour patterns similar to that of the second-grade teachers to which the third-grade teacher was obliged to respond. Children evidently have a high degree of flexibility in meeting their environments and are responsive to the personality patterns in teachers as recorded by the techniques employed.[4] It is claimed from these studies that a method

[1] II, pp. 119, 120.

[2] III, p. 17.

[3] III, p. 49.

[4] III, p. 65.

has been devised for dealing reliably with some of the so-called intangibles of teacher-child relations,[1] and that with a more economical procedure, the provision of norms of teachers' personalities can be more easily approached.[2]

The experimental studies outlined above indicate that for aspects of the educational process which were not previously regarded as amenable to scientific investigation, techniques are being devised which may allow these areas to be attacked with some hope of securing objective data and of increasing our insight into classroom behaviour.

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[1] Anderson, Brewer, Reed, III, p. 148.

[2] III, p. 154.

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